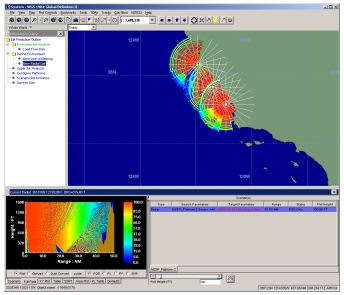
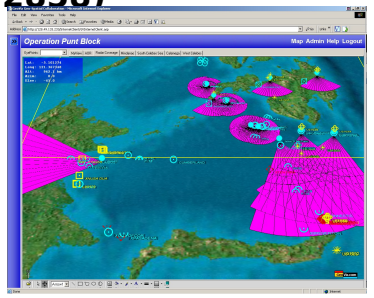
# Advanced Refractive Effects Prediction System

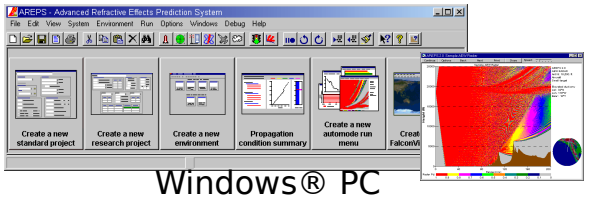


GCCS-M implementation



ForceNet implementation

Models developed under the EM propagation task transition via AREPS to fleet to support command and control, communications, surveillance, strike warfare and simulation.


AREPS - Advanced Refractive Effects Prediction System
File Edit View System Environment Run Options Windows Debug Help
Create a new standard project
Create a new research project
Create a new environment
Propagation condition summary
Create a new automode run menu

Windows® PC implementation NMCI approved

## Current operational uses

- Airborne & surface-based radar probability of detection
- ESM vulnerability
- VHF/UHF communications assessment
- Strike & electronic countermeasures assessment
- Early warning aircraft stationing
- HF ground and sky-wave assessment*

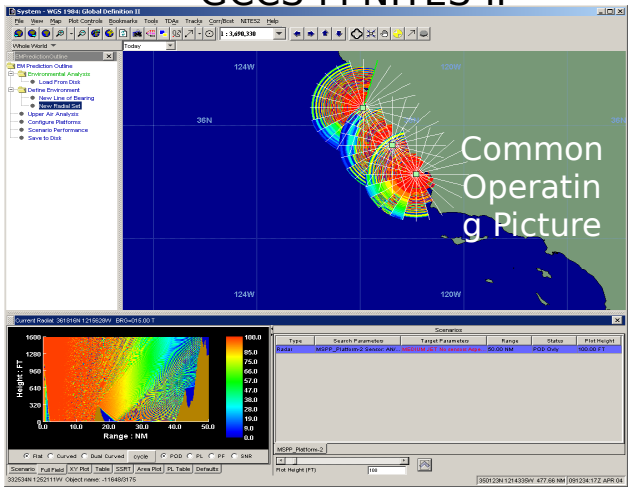
* HF communications implemented Still requires HF radar threshold model

# AREPS Features

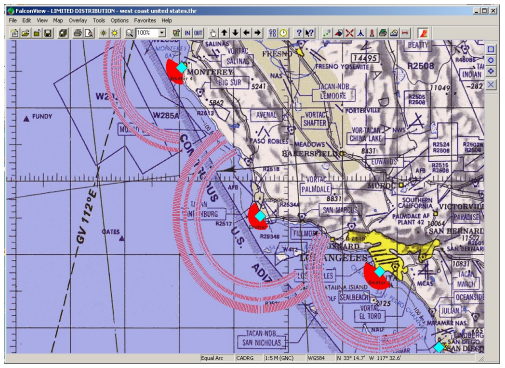
- **2 MHz - 57 GHz frequency range**
  - OpNav authorized propagation model
- **Range/bearing dependent environment**
  - Upper-air observations
  - Surface observations
  - Built-in climatology
  - Mesoscale meteorological models
- **Range and bearing variable terrain**
  - Rough ocean-surface
  - Surface clutter
  - Fixed or user-specific ground types
  - Automatic DTED level 0, 1, & 2
- **User maintained EM system database**
  - Radars
  - Communication systems
  - ESM receivers
  - Targets
  - Classified master database
- **User interface**
  - Microsoft Windows 95 - XP
  - GCCS-M / NITES II
  - Composable ForceNet
  - FalconView
  - Network configurable
- **Programmatics**
  - DII-COE compliant Windows 2000
  - NMCI approved
  - Government owned
  - License free
  - Tri-service
- **Technical support**
  - Internet / SIPRNET homepage
  - 24/7 METOC help-desk
  - FAQ’s
  - Software updates
  - On-line trouble reporting system
  - Extensive built in help
  - Formal school house training
  - User’s manual and other DII-COE documentation

# Various AREPS implementations

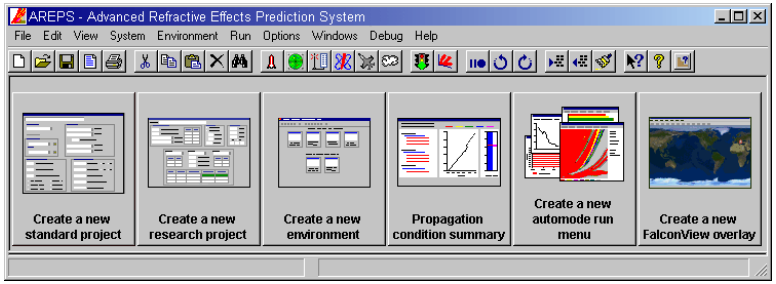
GCCS-M NITES-II

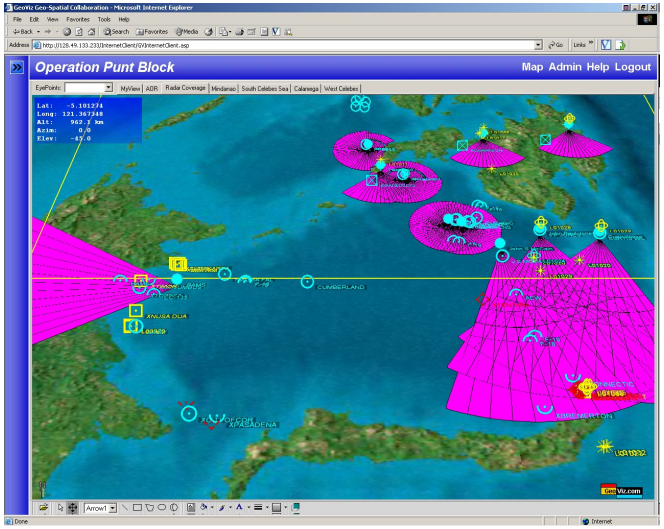



FalconView



Personal -PC


AREPS - Advanced Refractive Effects Prediction System
File Edit View System Environment Run Options Windows Debug Help
Create a new standard project
Create a new research project
Create a new environment
Propagation condition summary
Create a new automode run menu
Create a new FalconView overlay

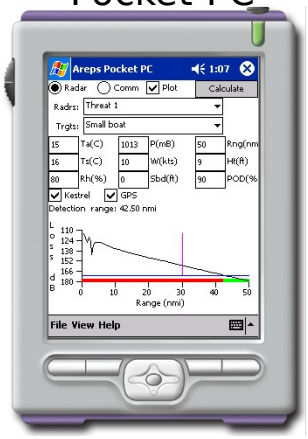



Composable ForceNet

(Current Installs)

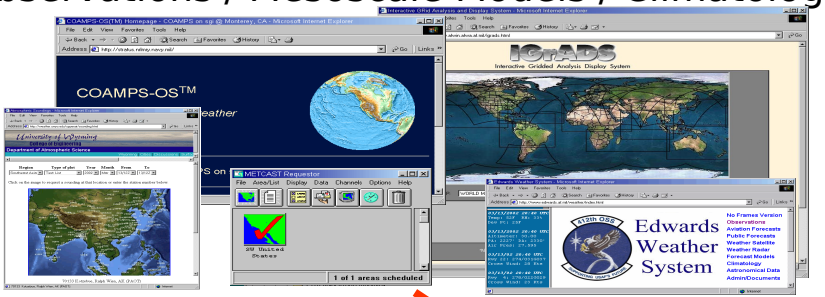
- CTF-74
- CTF-72
- CTF-72.2
- USS Blue Ridge

Pocket-PC

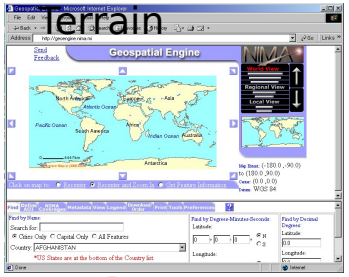


# AREPS Windows® Personal Computer Implementation

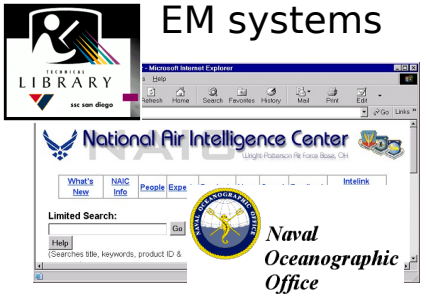
METOC in numerous formats
Observations / Mesoscale Models / Climatology

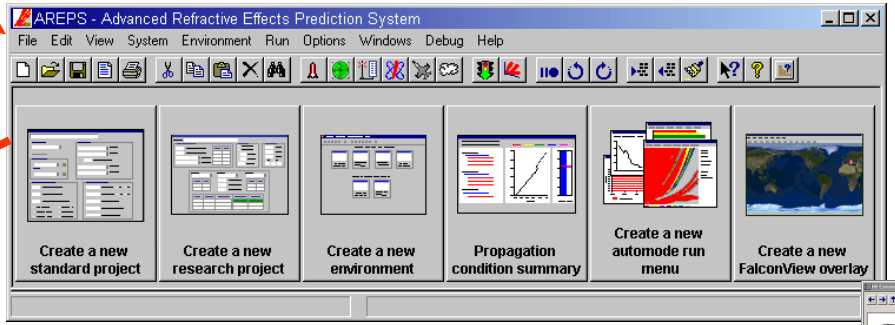



DTED terrain



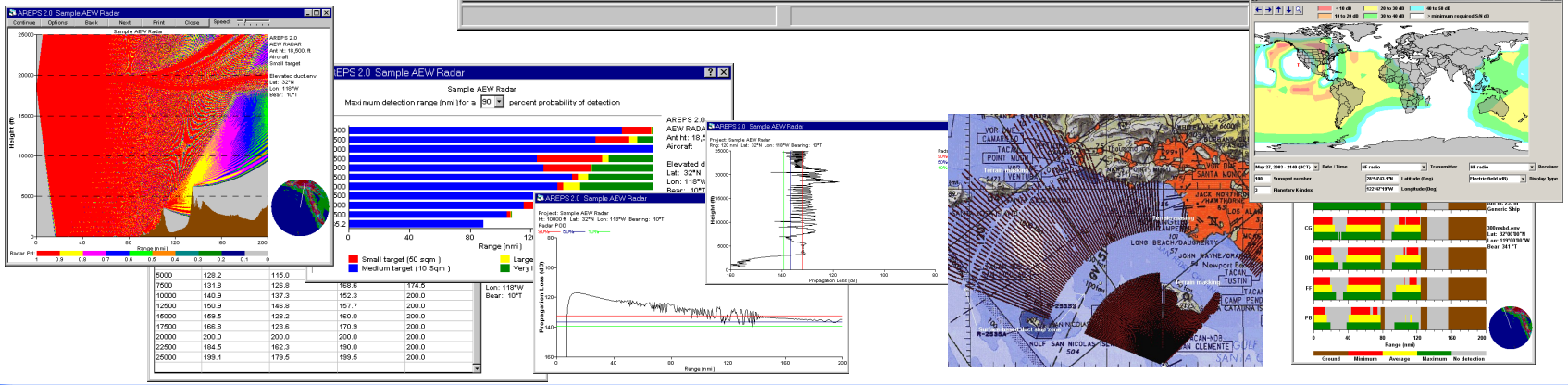

EM systems



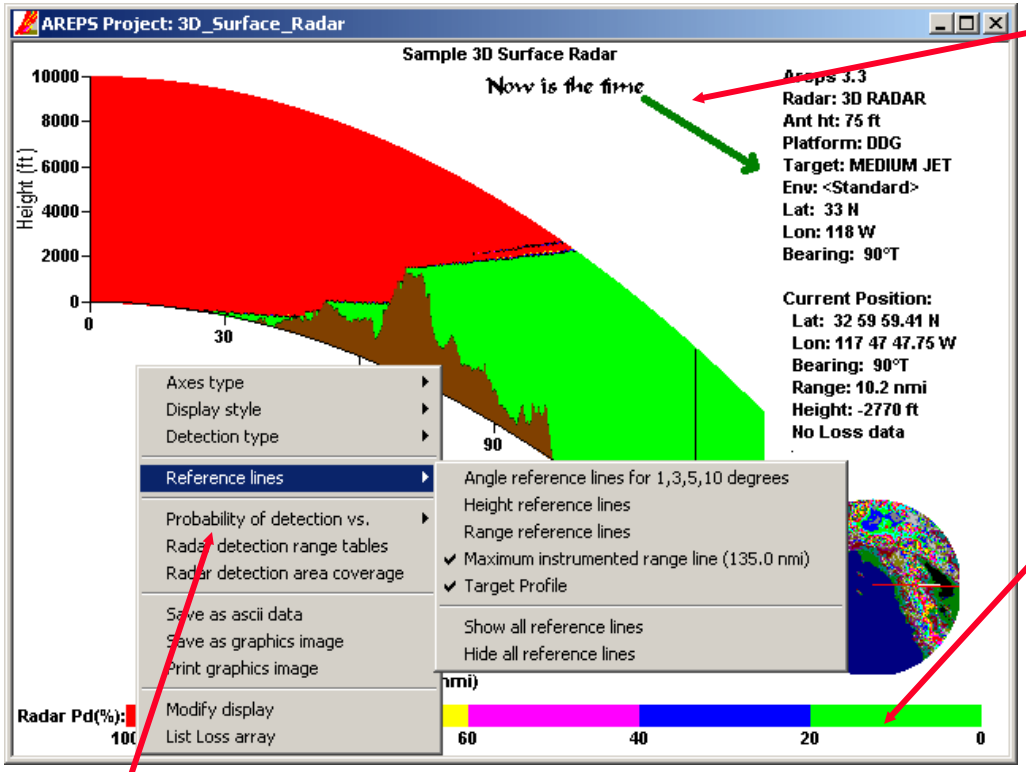


AREPS - Advanced Refractive Effects Prediction System
File Edit View System Environment Run Options Windows Debug Help
Create a new standard project
Create a new research project
Create a new environment
Propagation condition summary
Create a new automode run menu
Create a new FalconView overlay

Operator interface

Numerous decision



# Height versus Range Coverage Display

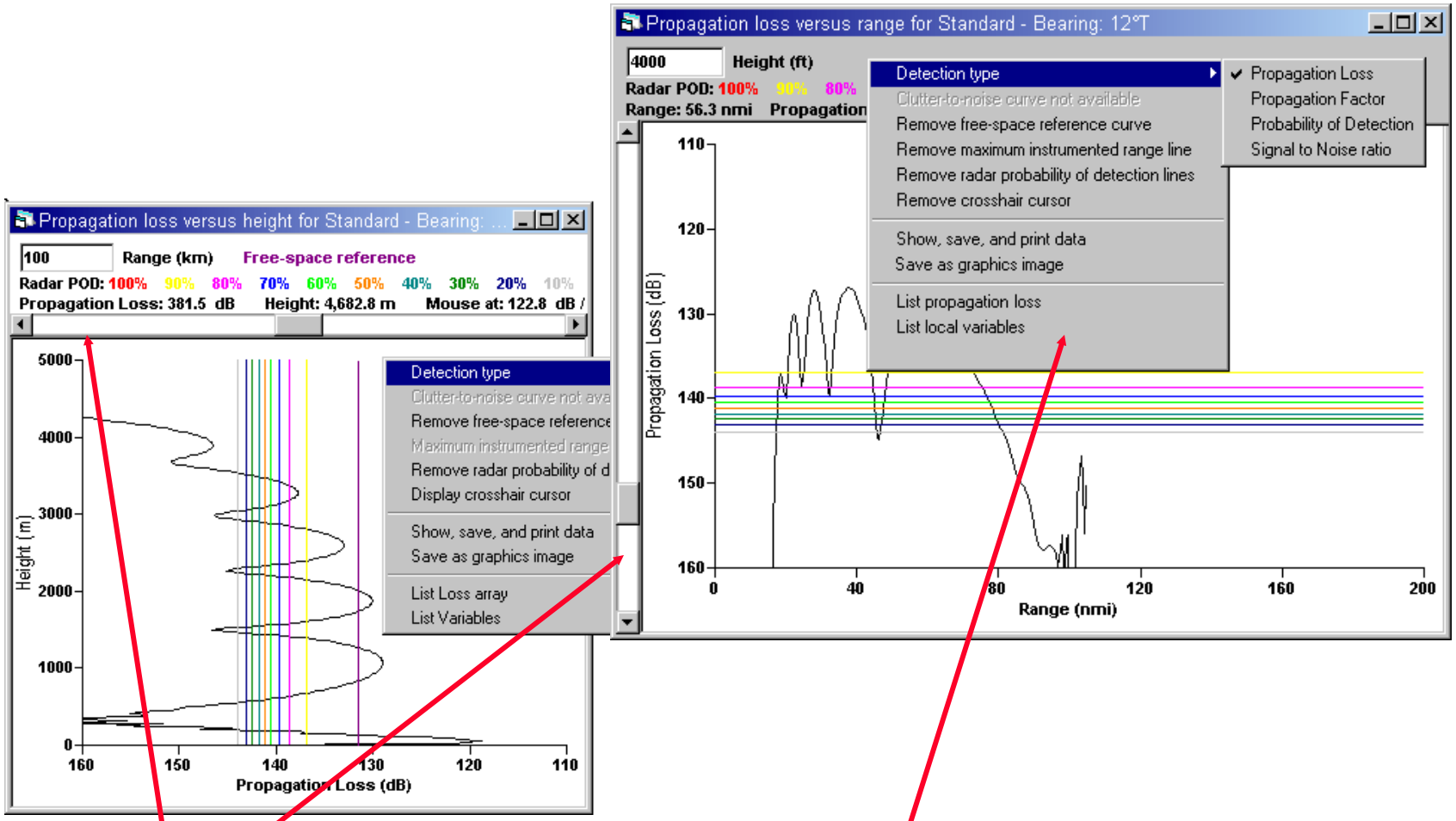



Personal annotation capability

Right click on legend to change colors

Right click on picture for popup menus

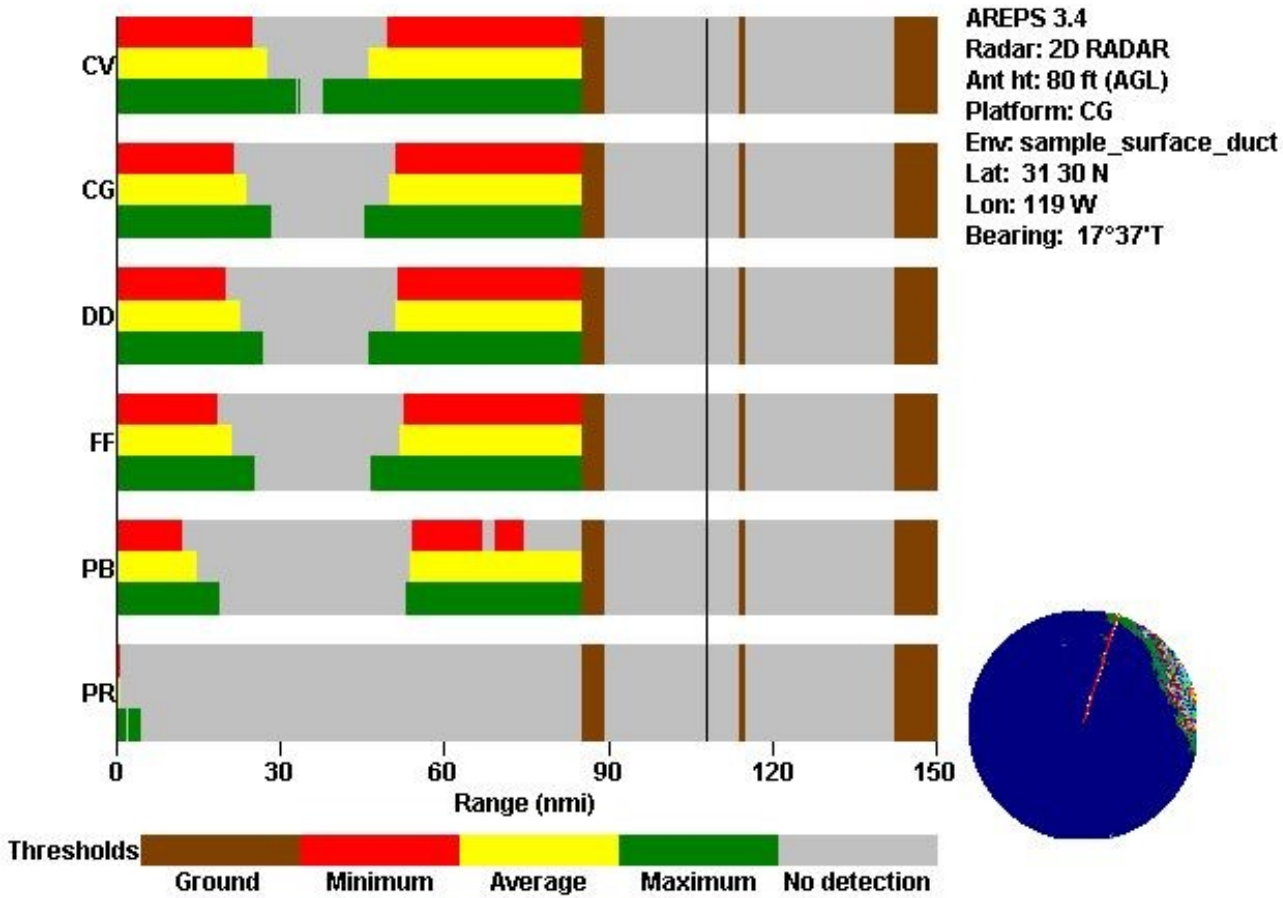
# Range/Height Displays




Scroll bar to change height/range

Right click on picture for popup menus

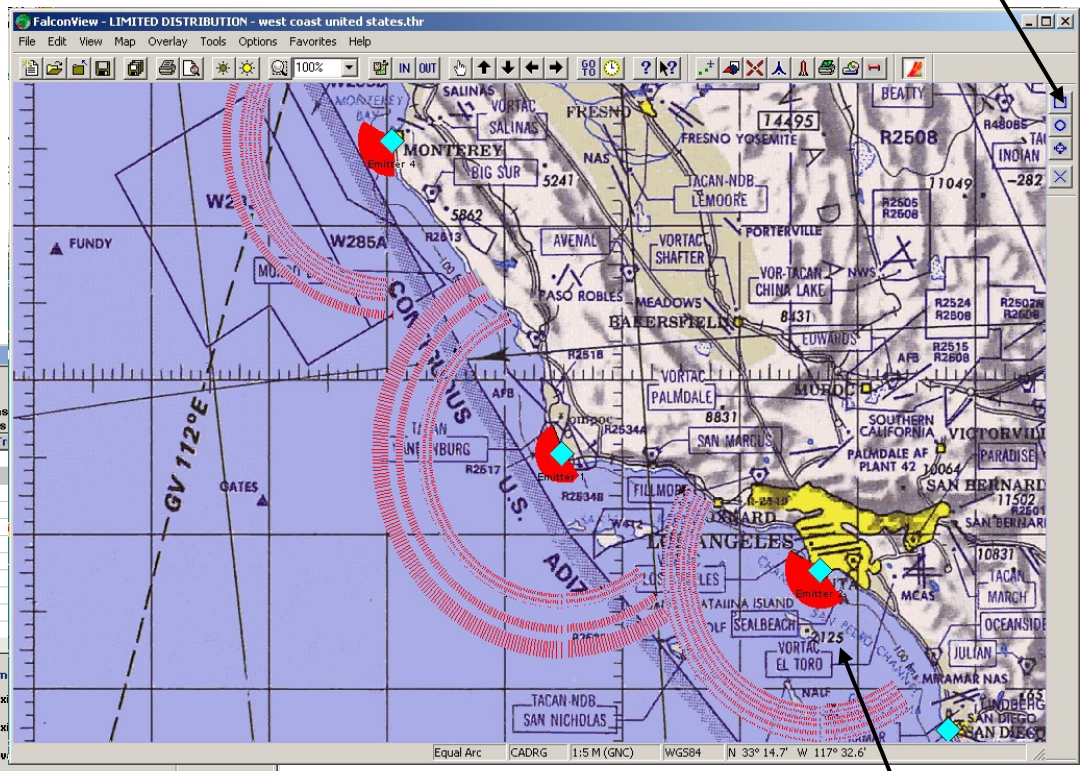
# Surface-search Table Display



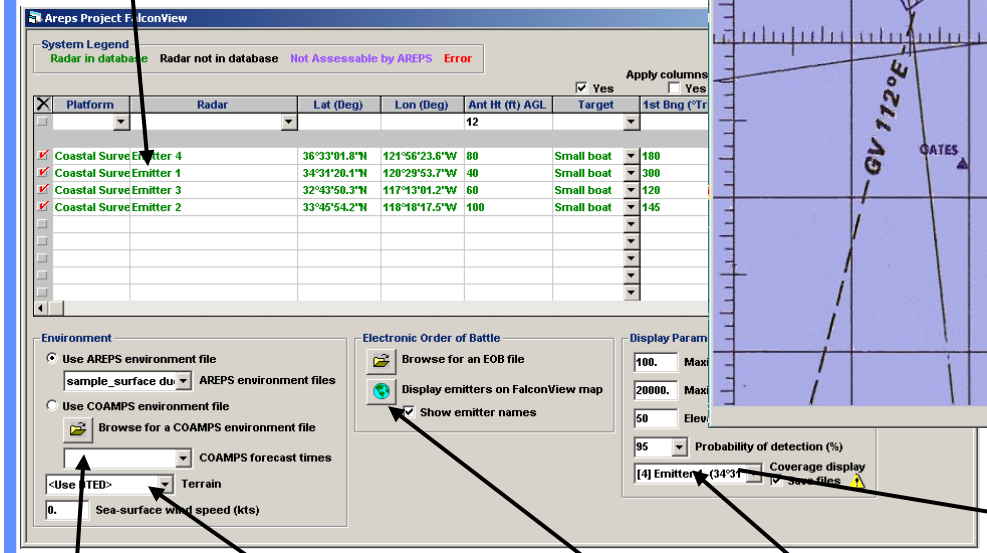
# FalconView Interface

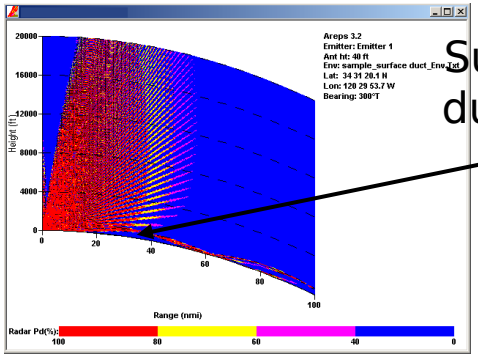
AREPS toolbar

FalconView display




Multiple emitters




DTED terrain

Import various EOB files

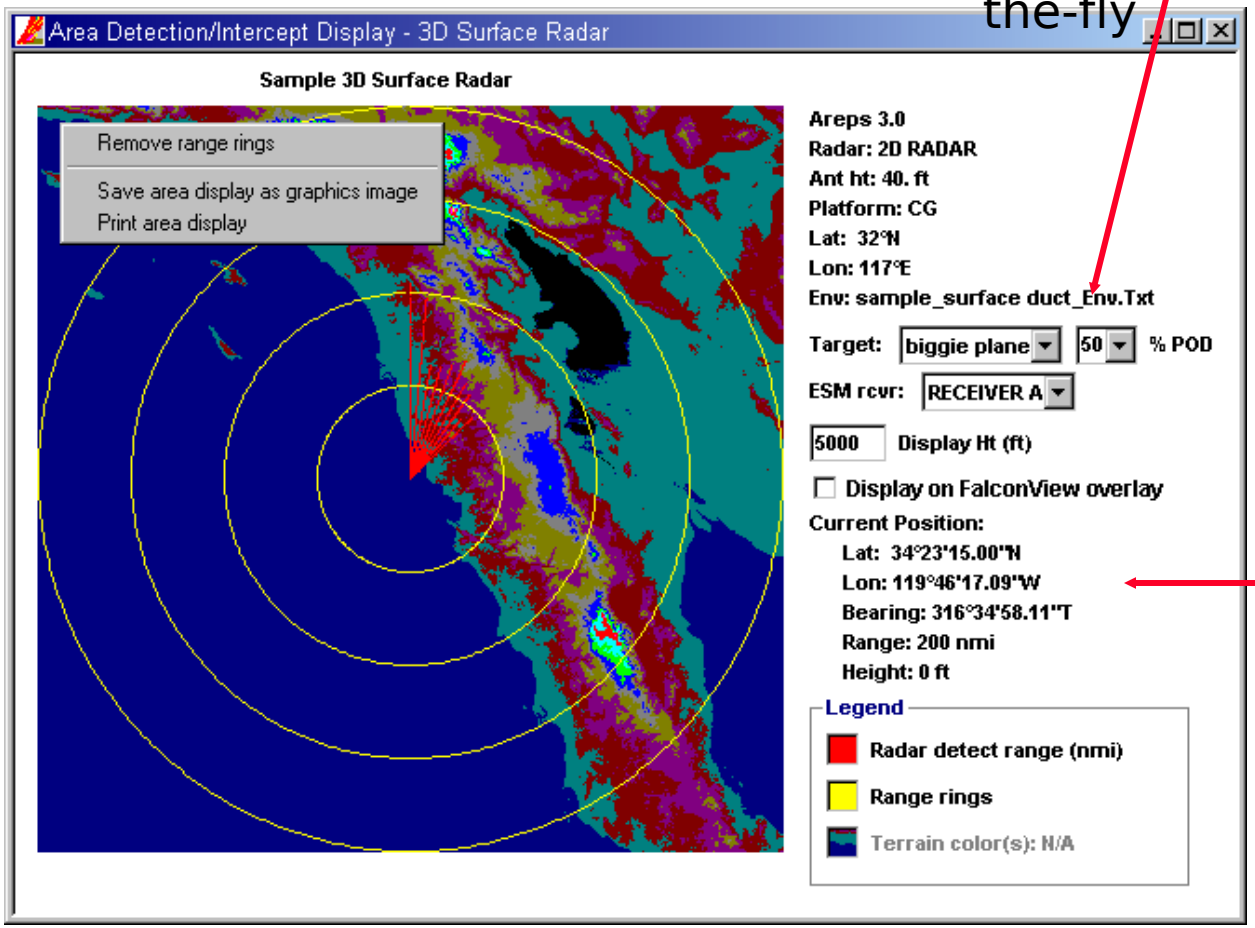
All normal AREPS displays

Surface-based duct skip-zone

Range & bearing environment data

# Area Display

Change targets, radar POD, ESM receiver, Comm receiver, & display height on-the-fly




Mouse move shows location and DTED terrain elevations.

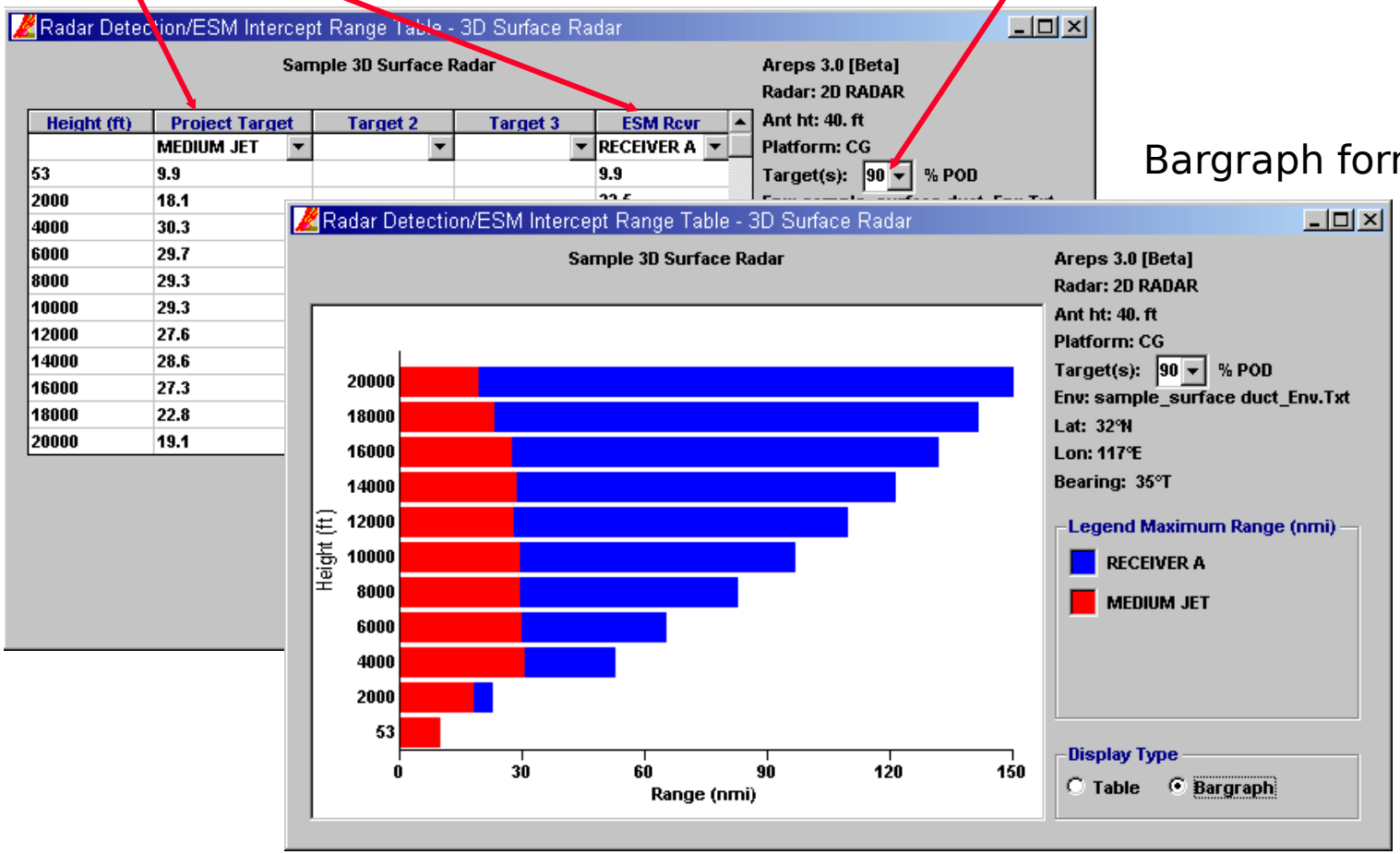
# Maximum Range Display

Multiple targets, ESM, and Comm receivers

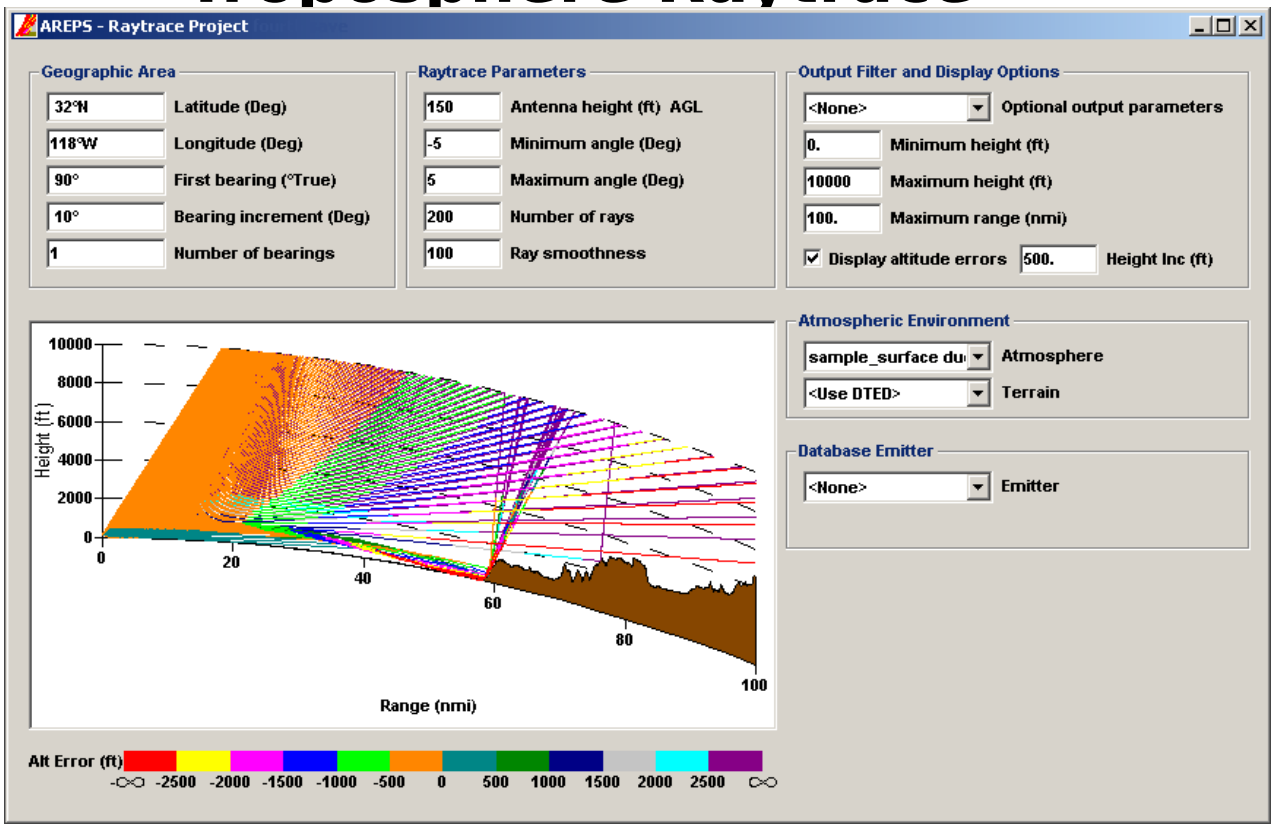
Table format

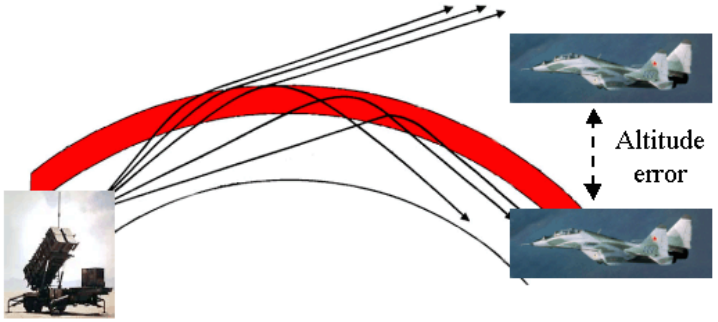
Change POD on-the-fly

Bargraph format



# Troposphere Raytrace




- Range / bearing dependent terrain (DTED data)
- Range / bearing dependent atmosphere
- Altitude errors
- Optional internal data output - angles, ranges, heights, times, etc.

SPAWAR Systems Center San Diego

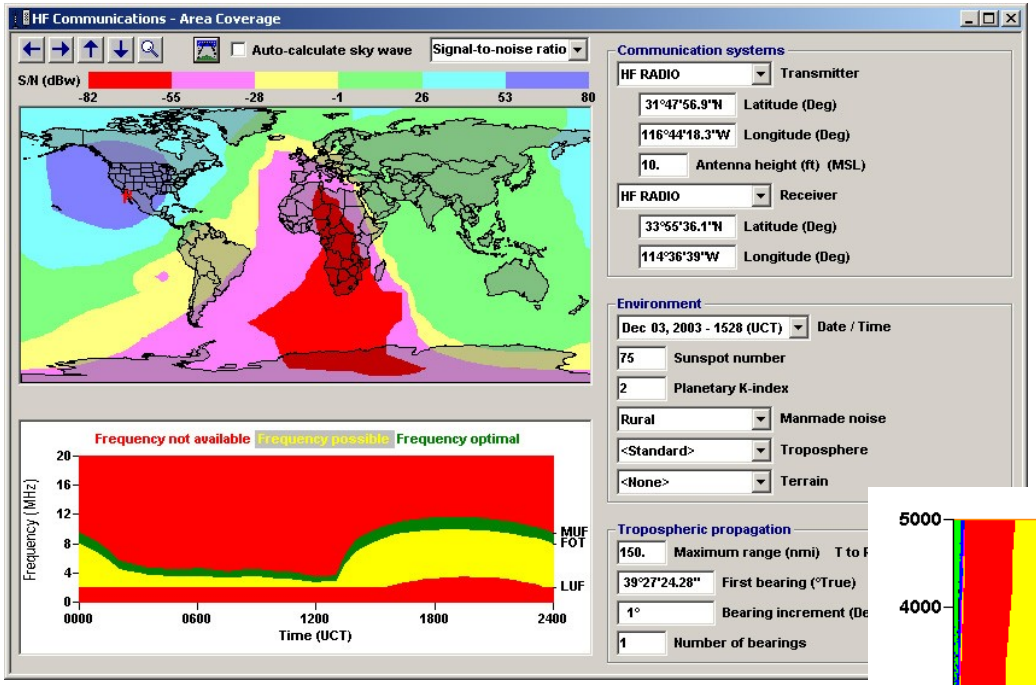
# HF communications

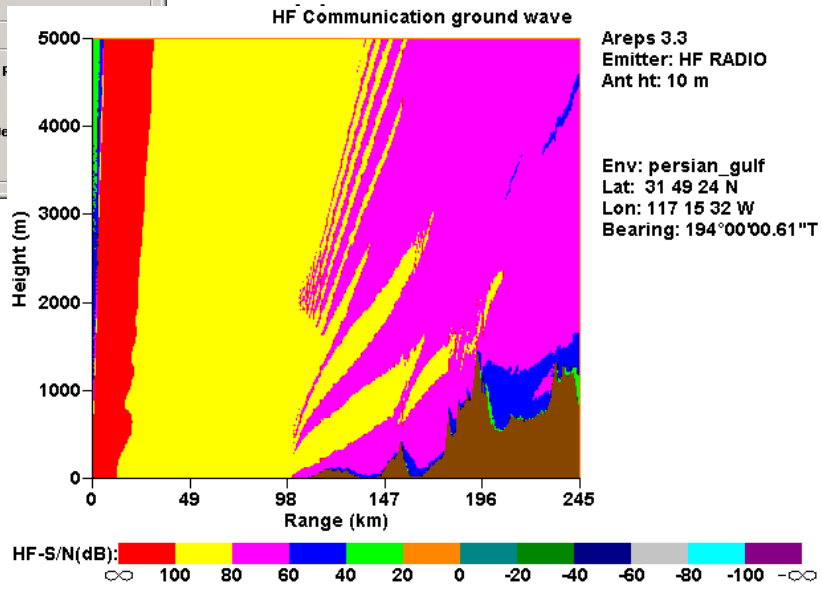
**Atmospheric Propagation Branch (2858)**

- Used to assess HF sky-wave in both area and point-to-point display

- Used to assess HF combined sky-wave and ground-wave

- Propagation loss, electric field, signal-to-noise, received power, MUF,LUF,FOT, terrain

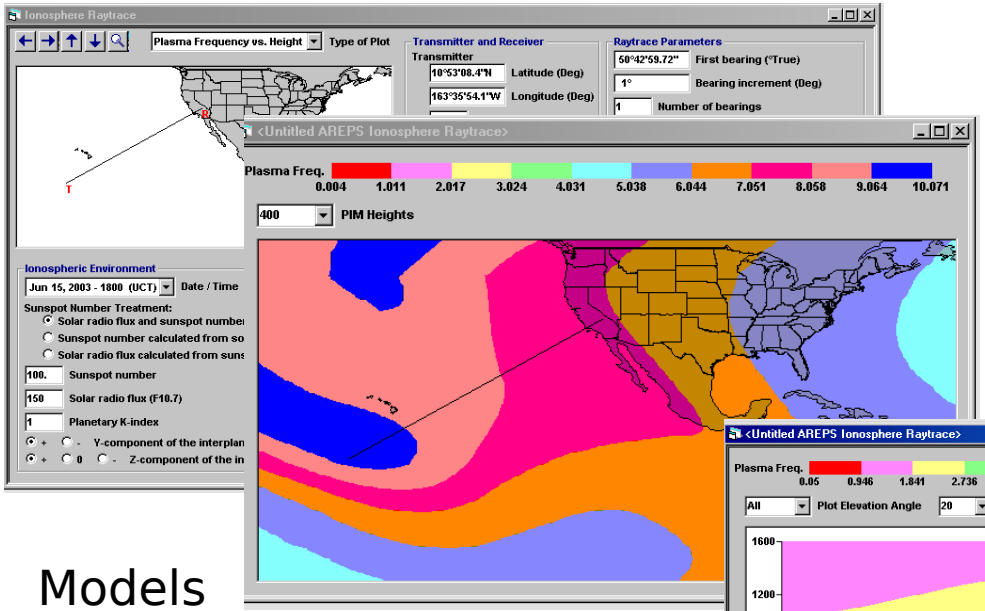


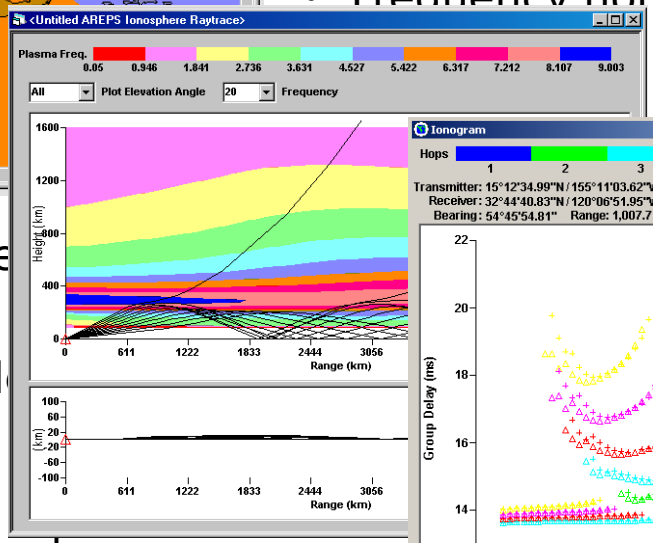



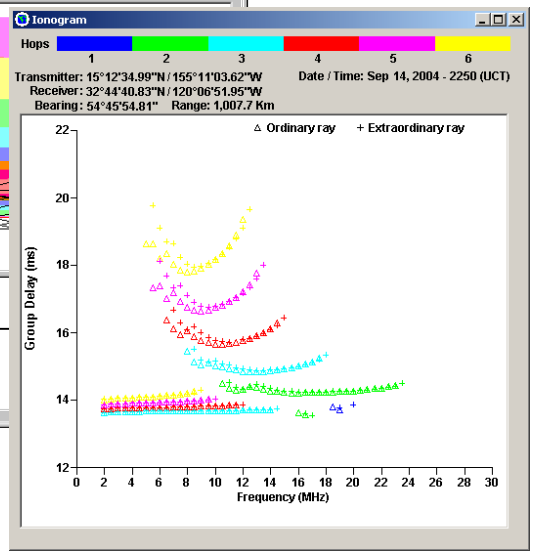

- Reads environment from a file created with the environment program and ionospheric data obtained via AREPS homepage.

- Reads terrain from DTED or a custom file.

# HF Ionosphere Raytrace Communications & Radar




- Multiple azimuths, elevations, and frequencies
- Ray display - elevation and azimuth
- Plasma frequency contours in vertical and horizontal planes
- Contours of F2 and E region critical parameters
- Frequency homing

## Models

- Jones-Stephenson 3-D ionosphe
  with geo-magnetic field
- Parameterized Ionosphere Mod
  (PIM 1.7)
- Future
  International Reference Ionosphere
  User plug-ins

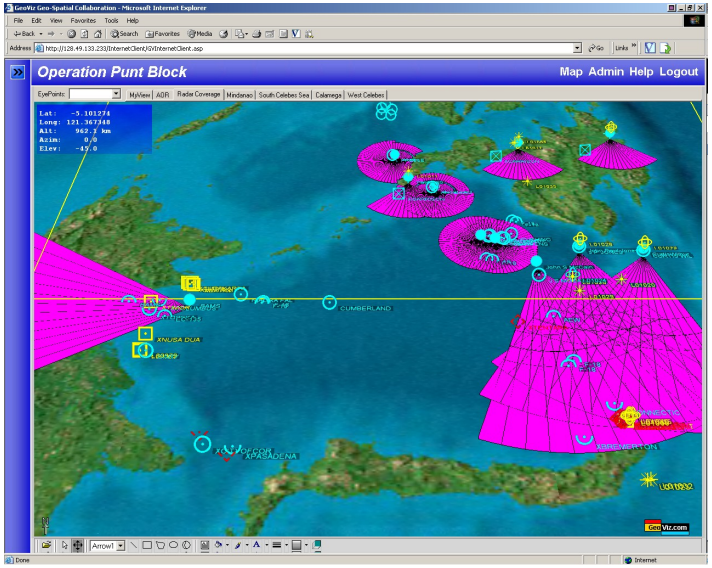
SPAWAR
Systems Center
San Diego

# AREPS Server Mode

## Composable ForceNet

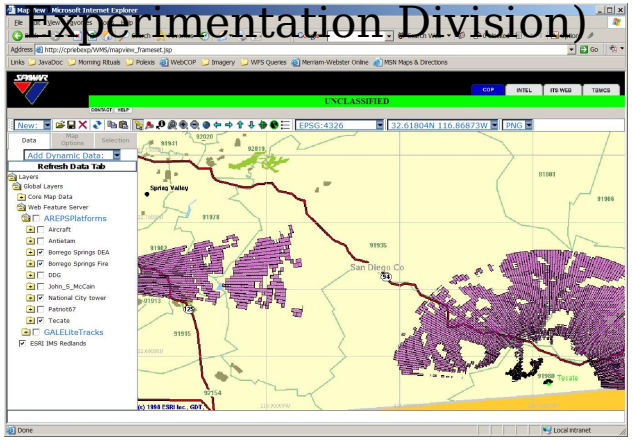
(Current Installs)

- CTF-74
- CTF-72
- CTF-72.2
- USS Blue Ridge



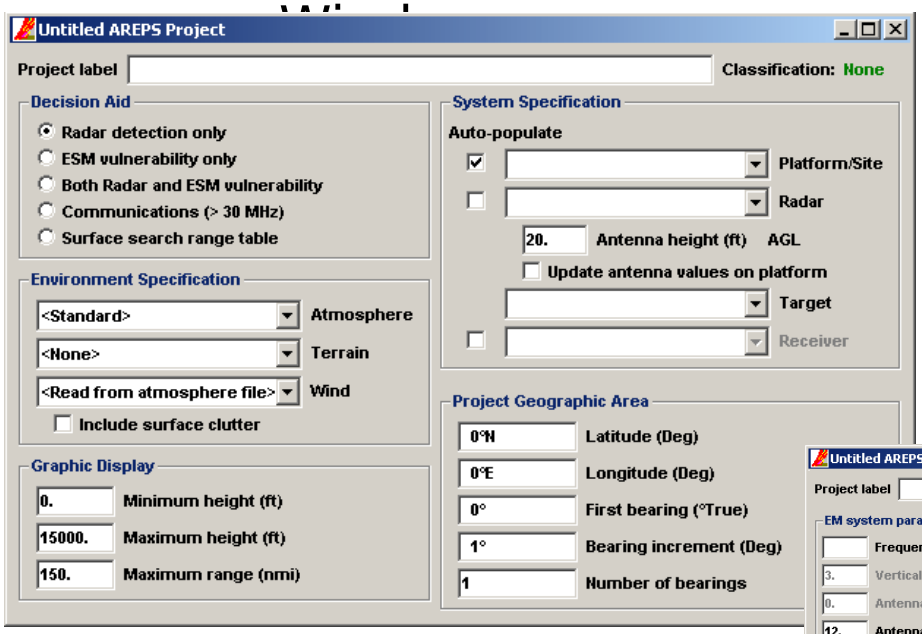

1. Runs on a background server
2. Uses COAMPS grid data from DAMPS
3. No AREPS operator intervention
4. Accessed via Application GUI

Lessons Learned Proposal effort
(SSC 246 Command and Control Technology and Experimentation Division)

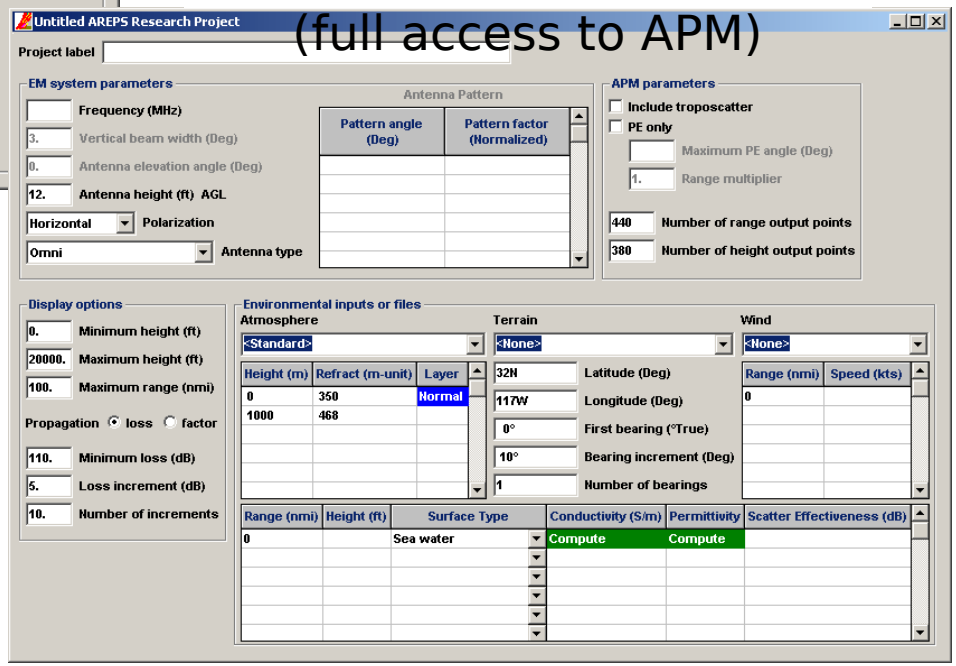


Emergency Response UHF communications East County San Diego

# Standard Project Window



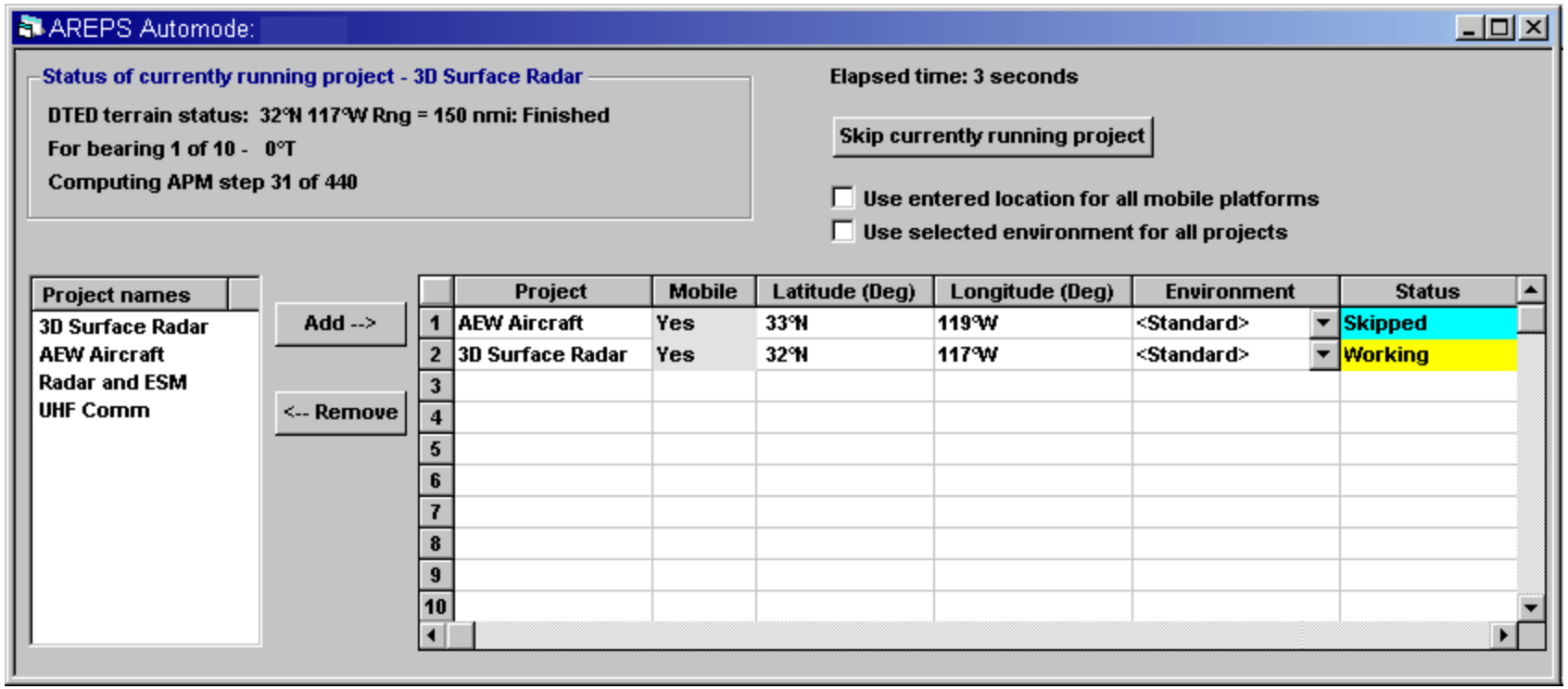

# Research Project Window (full access to APM)




Numerous right-click popup menus

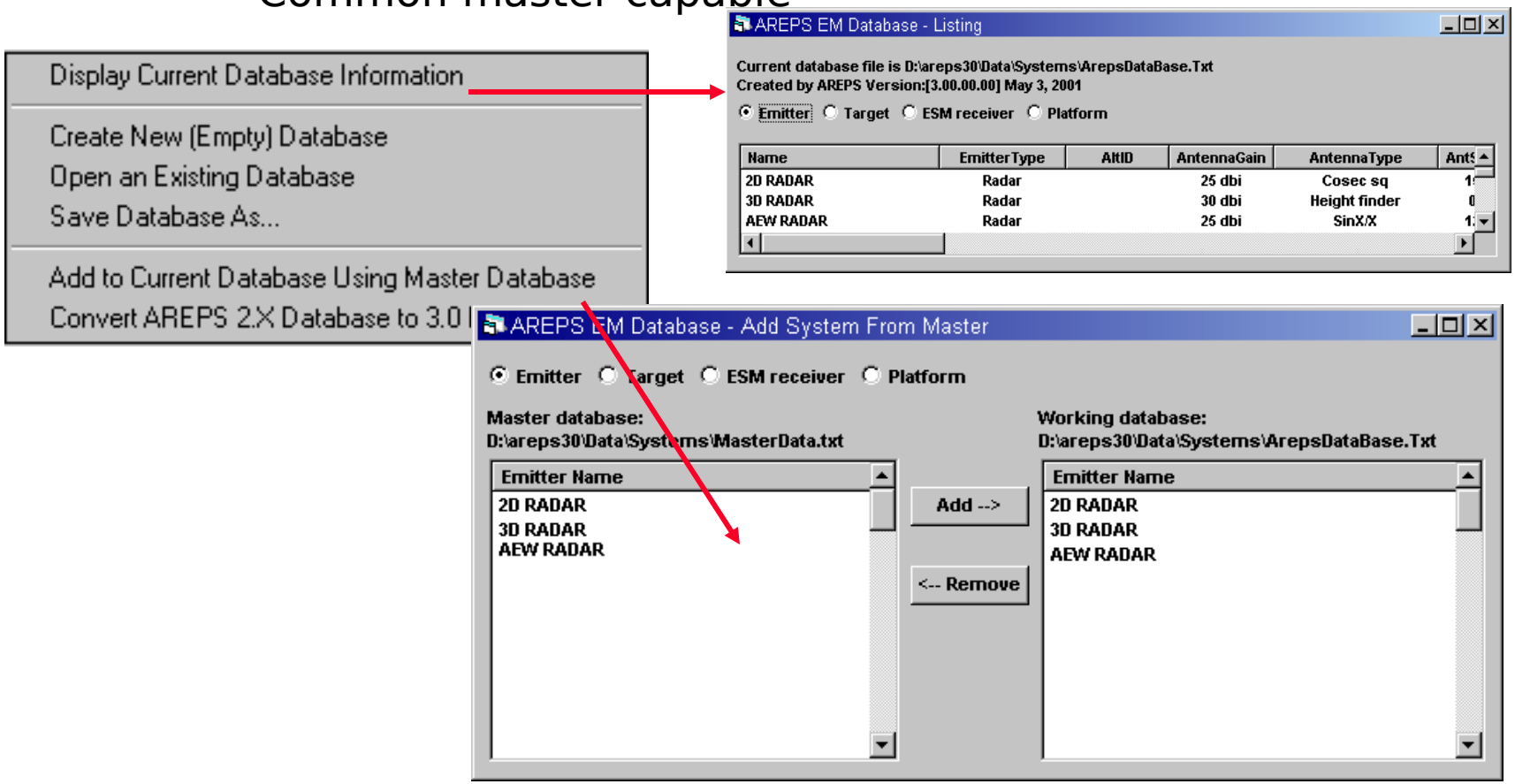
# Automode Menu Window

Run multiple projects in batch “hands-off” process



# EM System Database

- ASCII text
- Easily transportable
- User maintained
- Common master capable

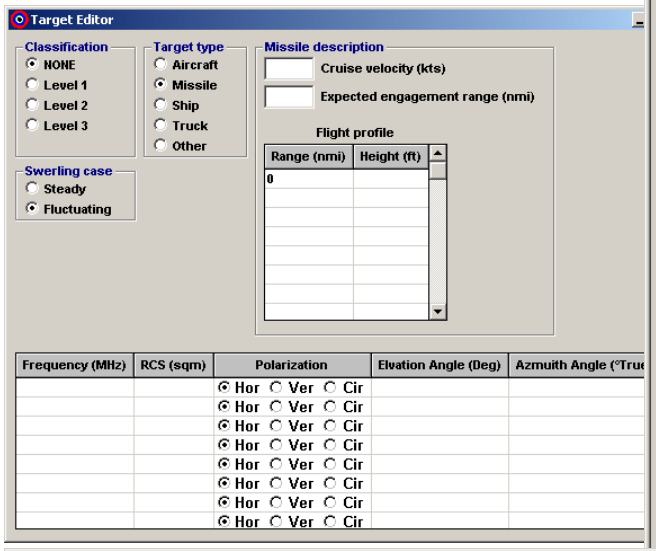


SPAWAR Systems Center San Diego

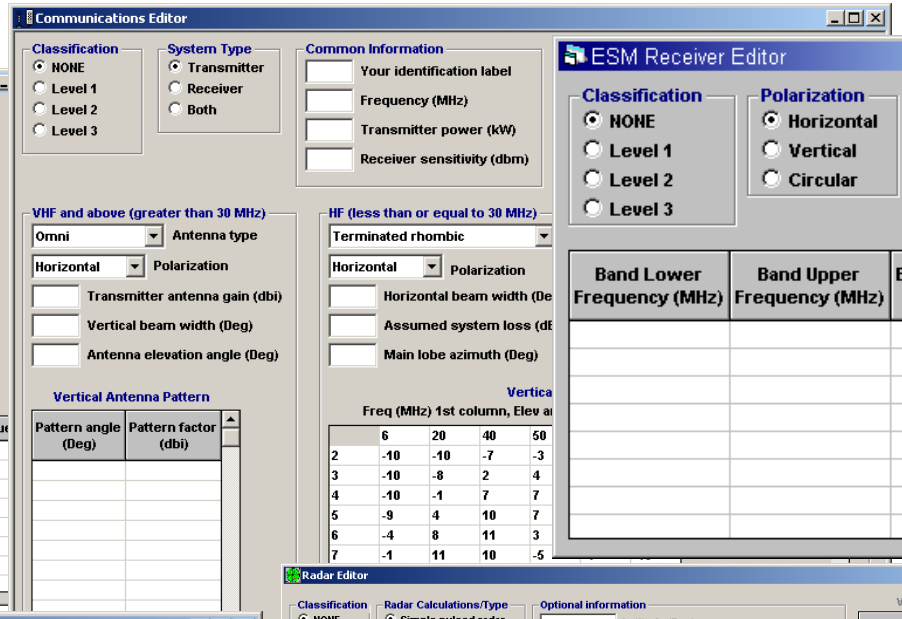
**Atmospheric Propagation Branch (58)**

# System Input/Editing Windows

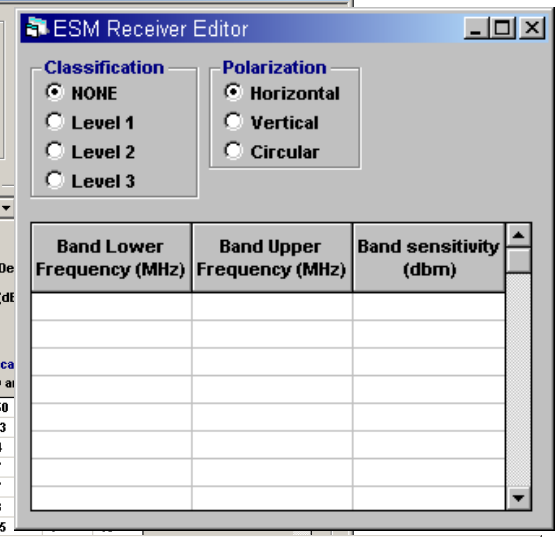
## Targets



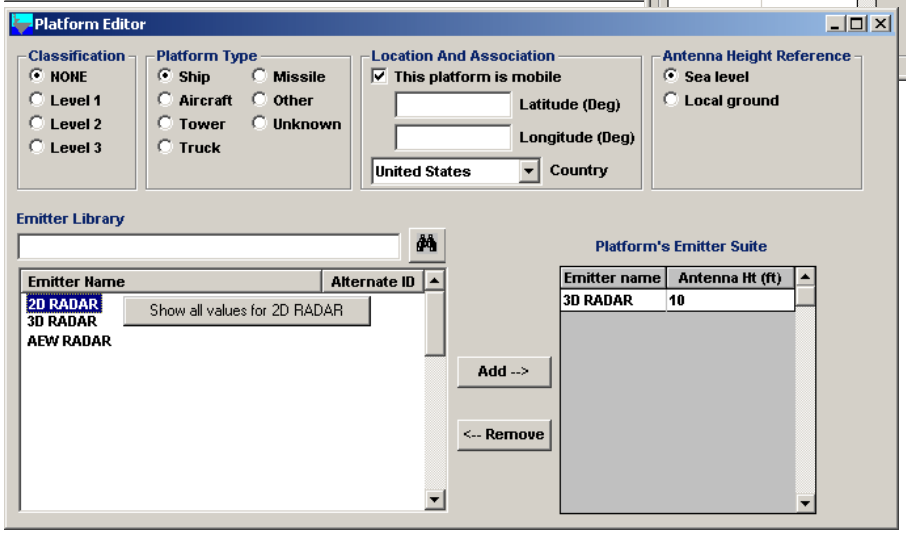

## HF to EHF Communications



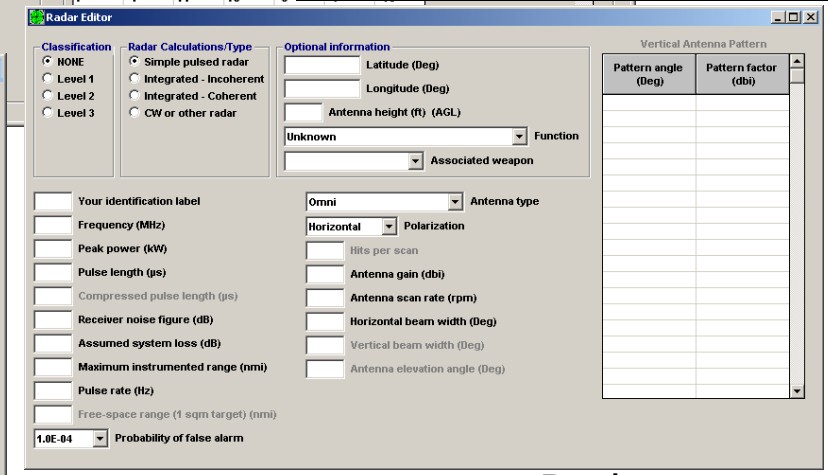

## ESM receivers




## Platforms

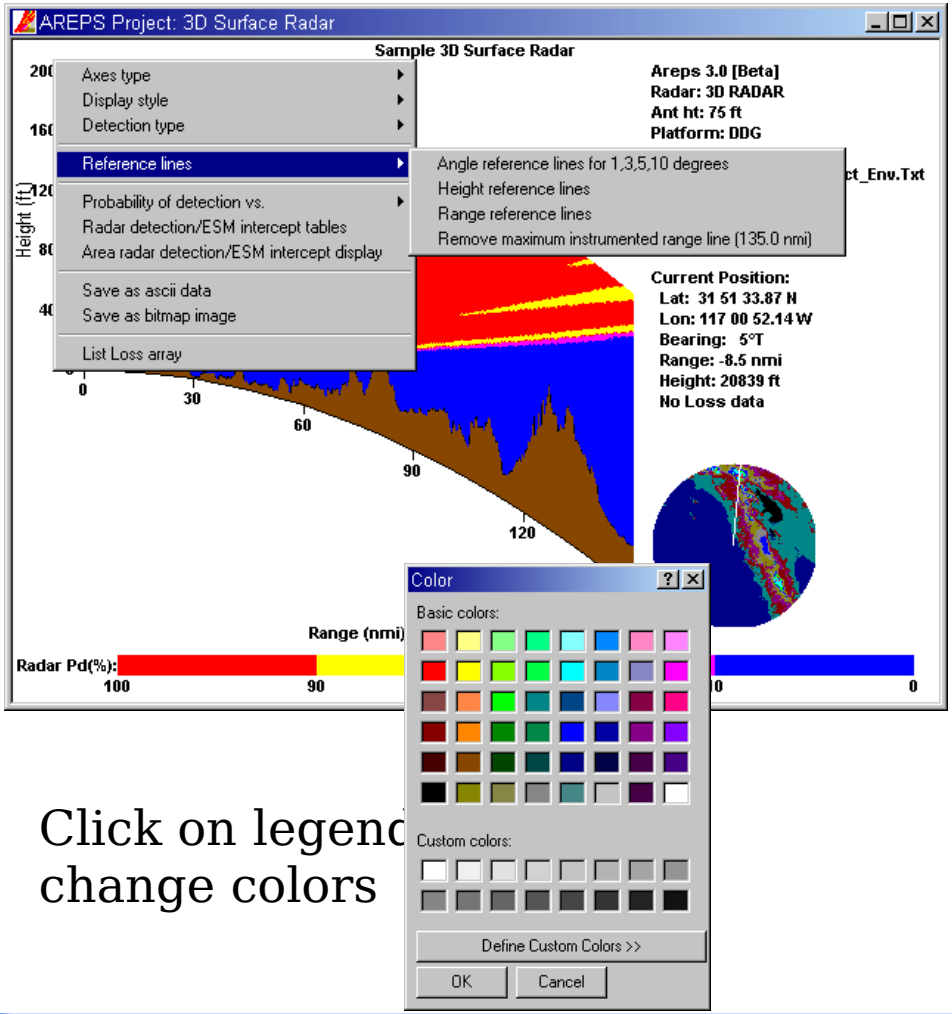



## Radars

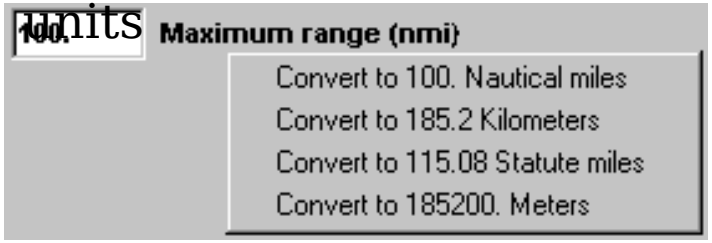


# Numerous Popup Menu Options

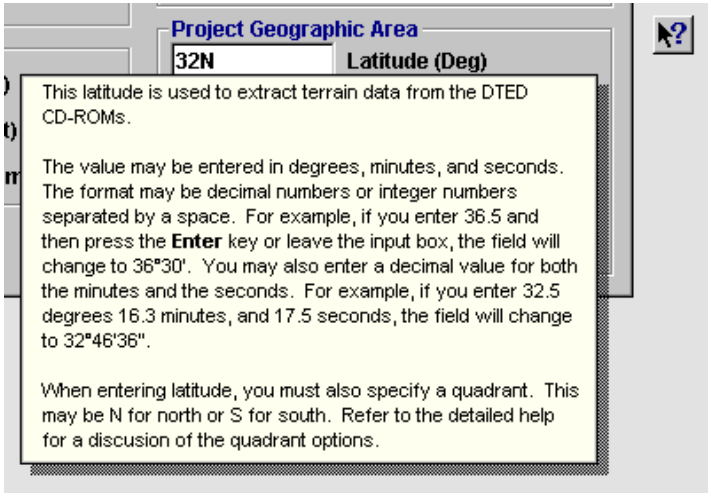
Click on picture for display options




Click on label to change units



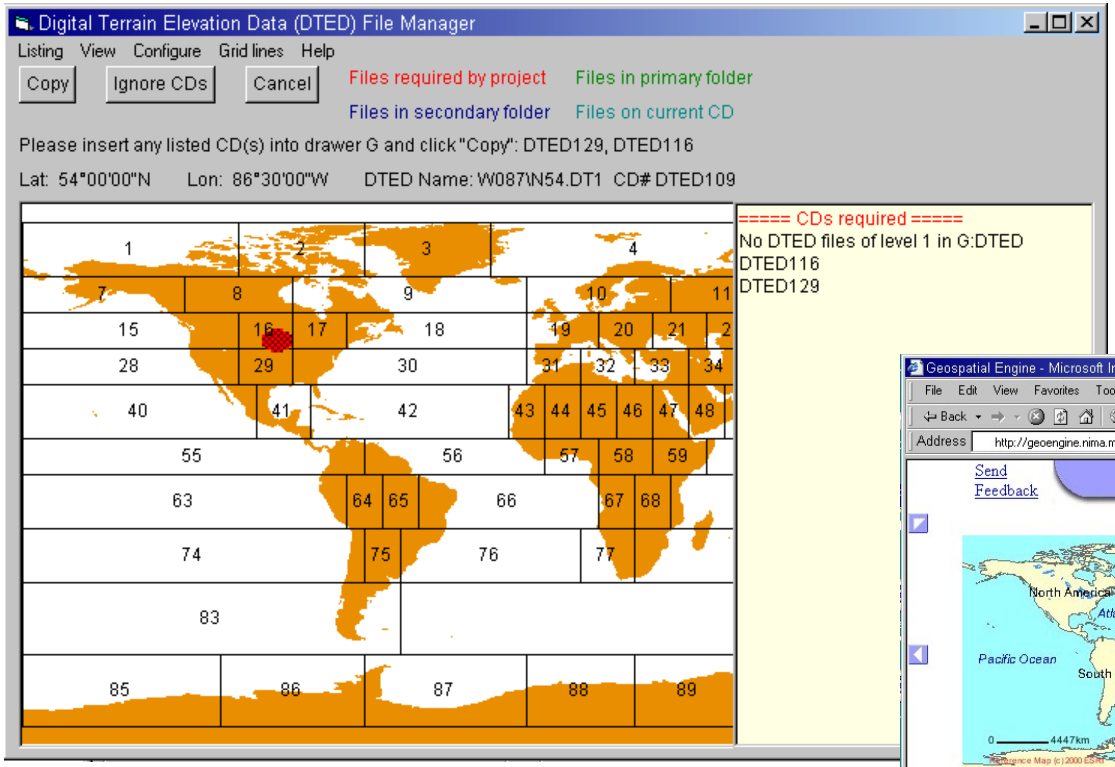

Click on input field for help

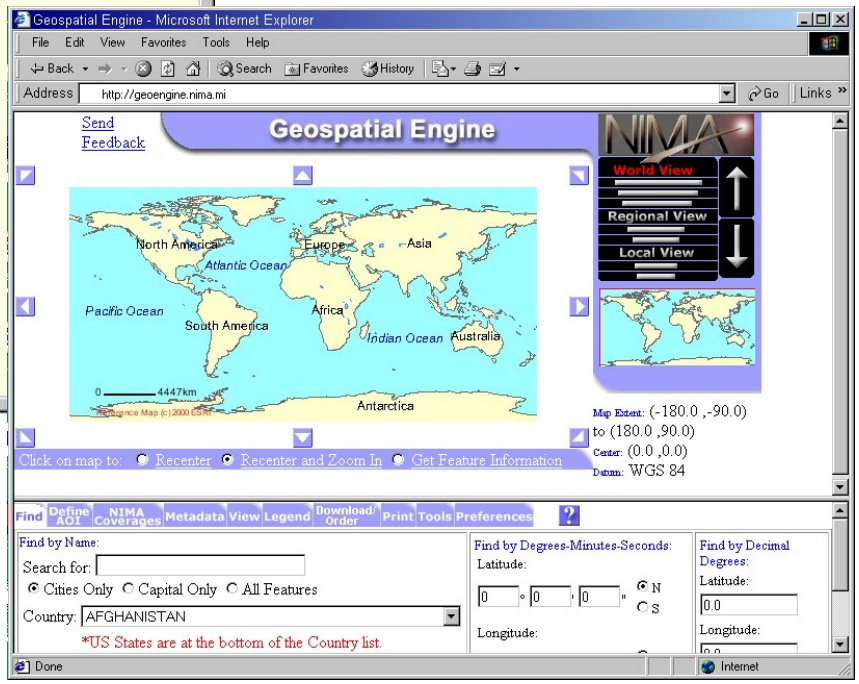

Project Geographic Area
32N
Latitude (Deg)
This latitude is used to extract terrain data from the DTED CD-ROMs.
The value may be entered in degrees, minutes, and seconds. The format may be decimal numbers or integer numbers separated by a space. For example, if you enter 36.5 and then press the Enter key or leave the input box, the field will change to 36°30'. You may also enter a decimal value for both the minutes and the seconds. For example, if you enter 32.5 degrees 16.3 minutes, and 17.5 seconds, the field will change to 32°46'36".
When entering latitude, you must also specify a quadrant. This may be N for north or S for south. Refer to the detailed help for a discusion of the quadrant options.

Click on legend to change colors

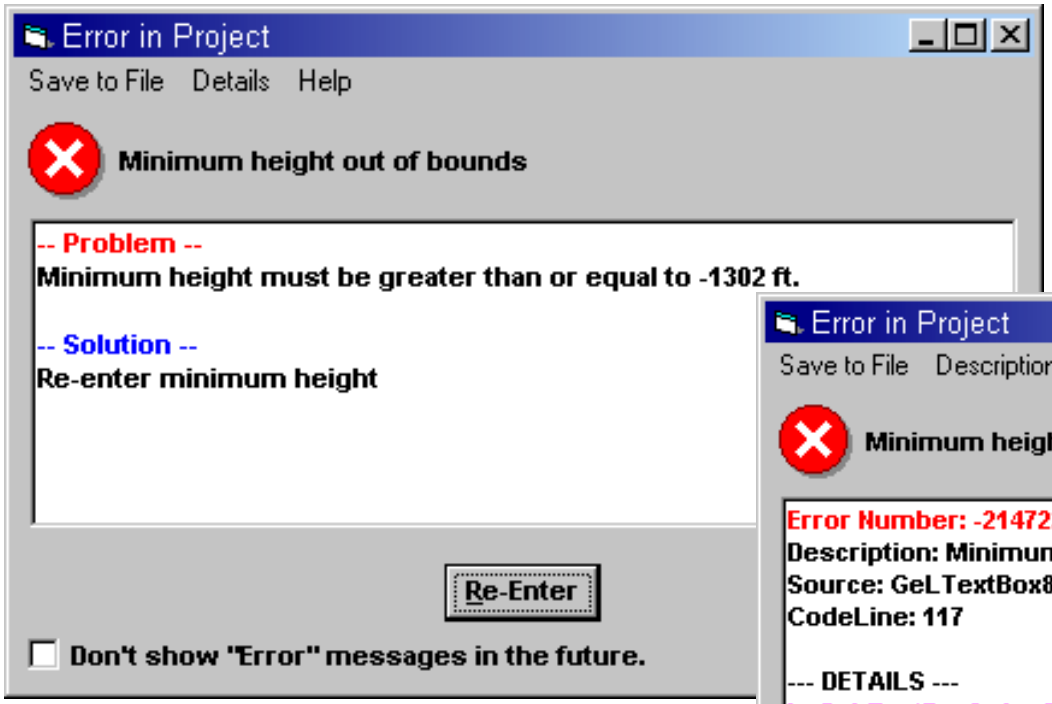
# Digital Terrain Elevation Data File Manager

## Can use level 0, 1, and 2 DTED data


Digital Terrain Elevation Data (DTED) File Manager
Listing View Configure Grid lines Help
Copy
Ignore CDs
Cancel
Files required by project
Files in primary folder
Files in secondary folder
Files on current CD
Please insert any listed CD(s) into drawer G and click "Copy": DTED129, DTED116
Lat: 54°00'00"N Lon: 86°30'00"W DTED Name: W087\N54.DT1 CD# DTED109
===== CDs required =====
No DTED files of level 1 in G:DTED
DTED116
DTED129

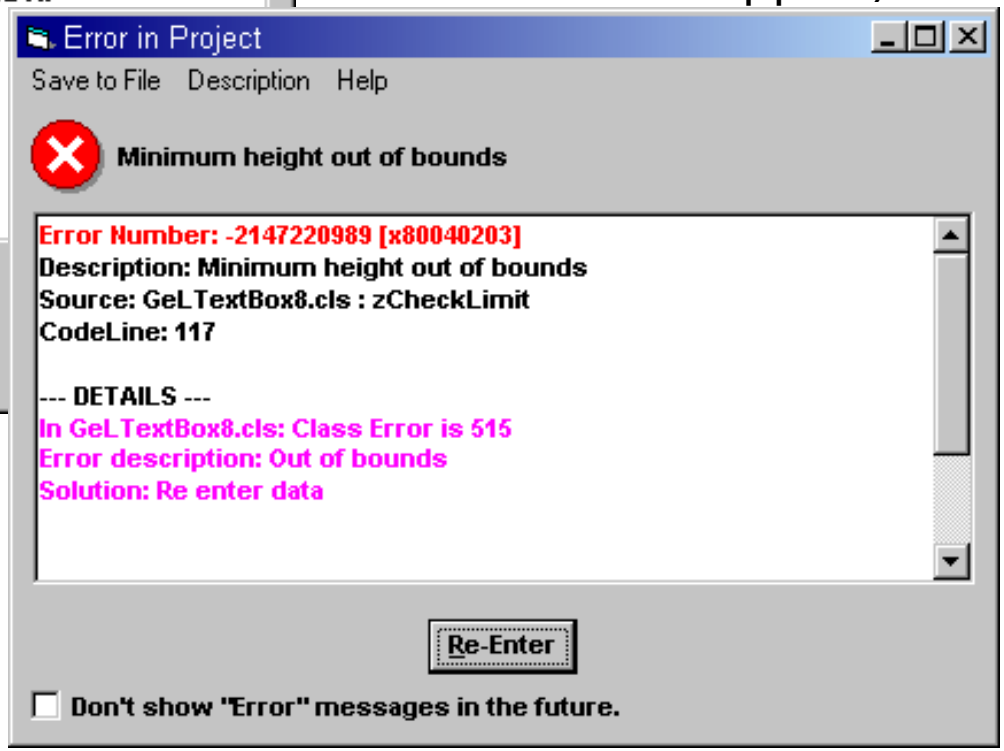


# Message & Error Window




Details View

(message to technical support)

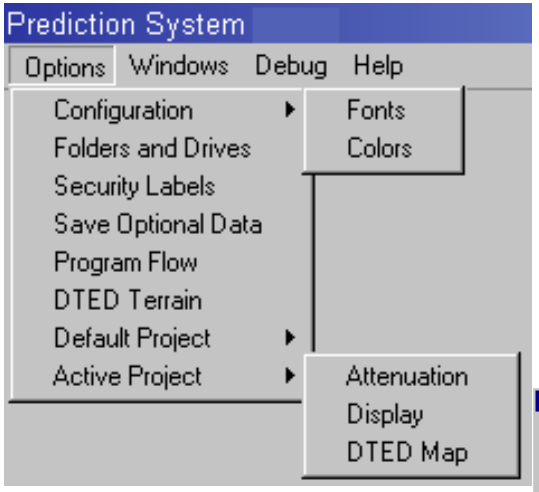


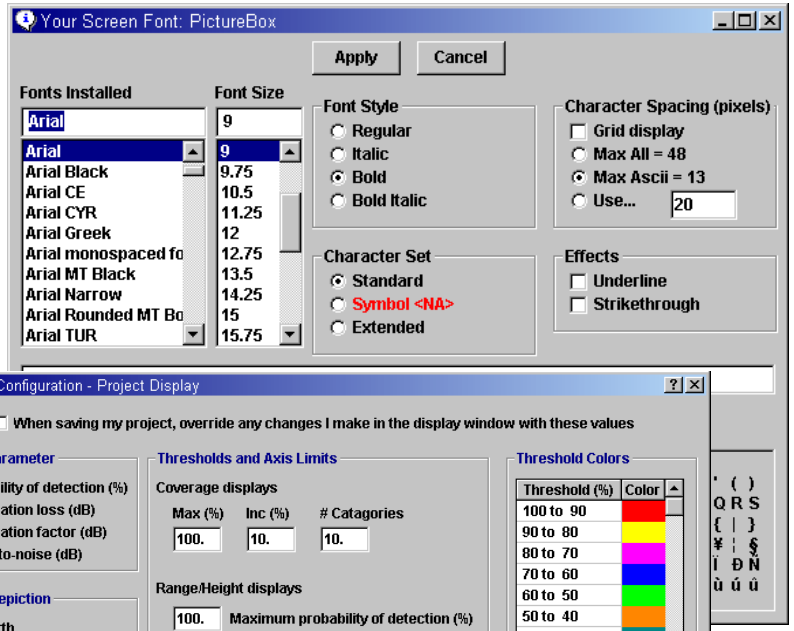

Description View

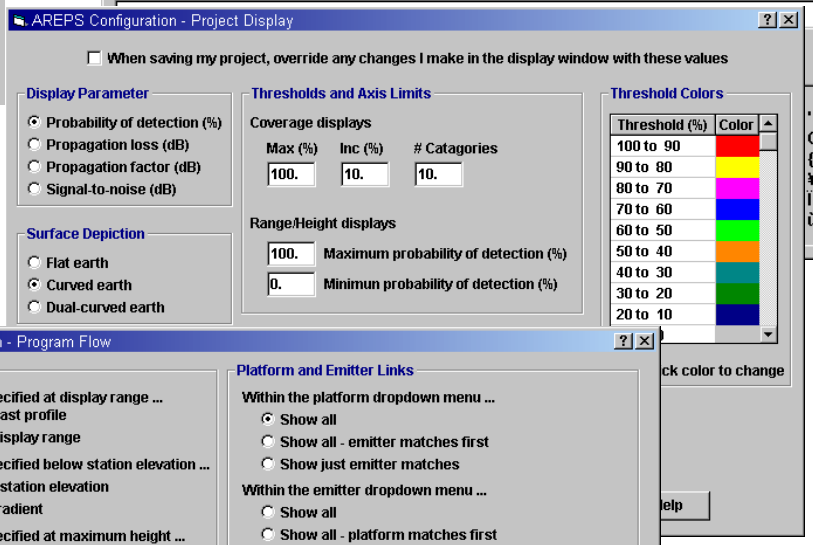
(message to user)

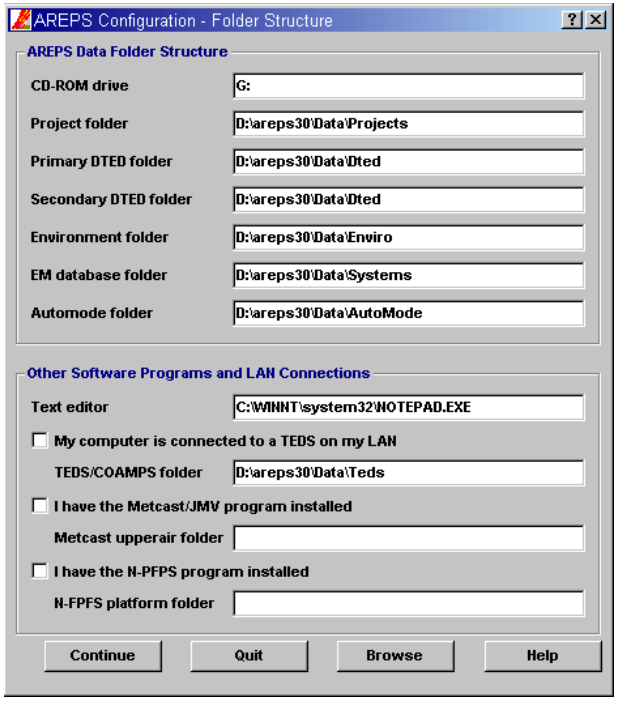
New - “Don’t show option”

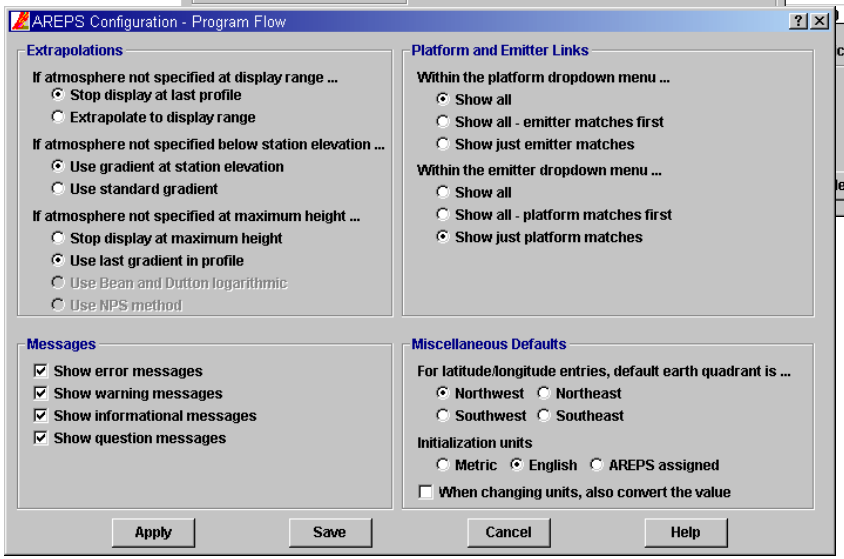
# Numerous Options



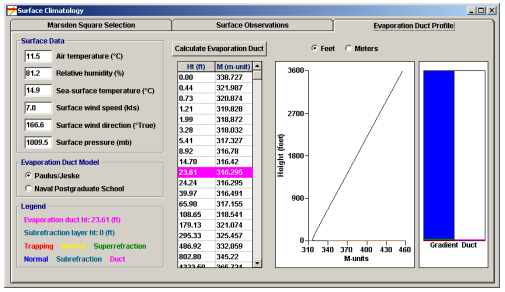
# Numerous Environment Data Sources

- **WMO Code**
- **Climatology**
- **Metcast/JMV**
- **Custom**

**Columns**

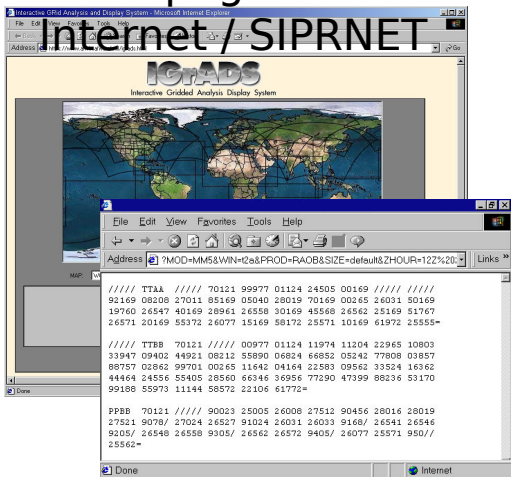
- **COAMPS / MM5**

## Local Observations

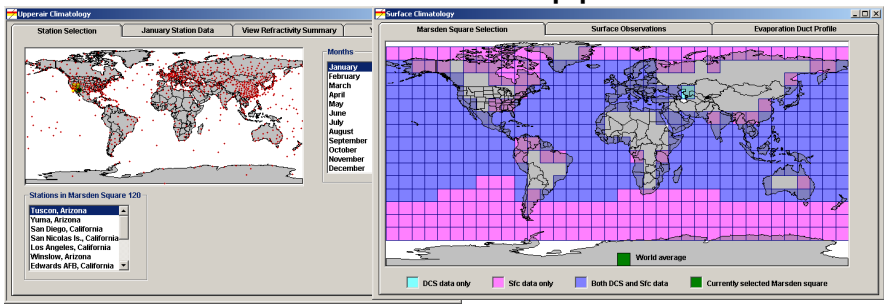



## JAAWIN Homepage

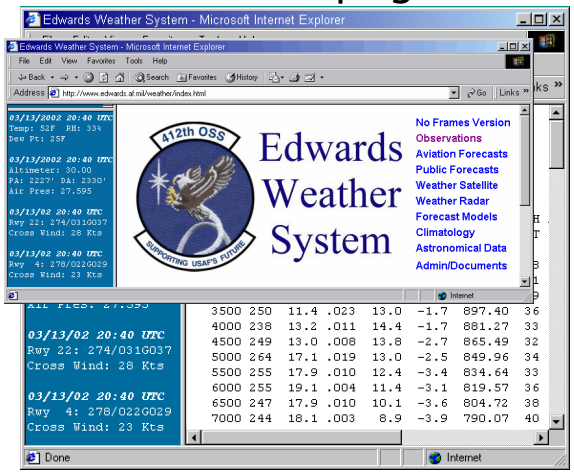
## Internet / SIPRNET



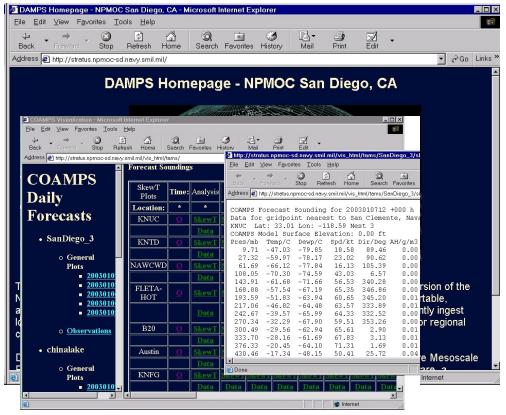

## Built-in Surface and Upper-air



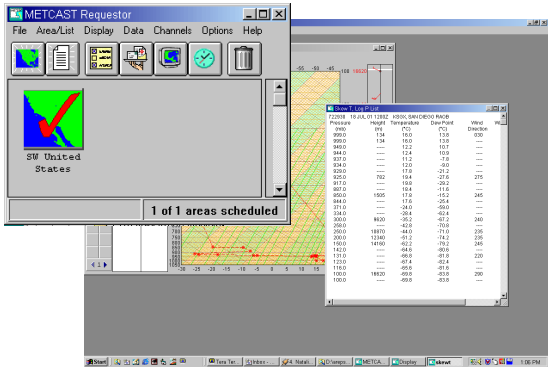

## DoD Homepages



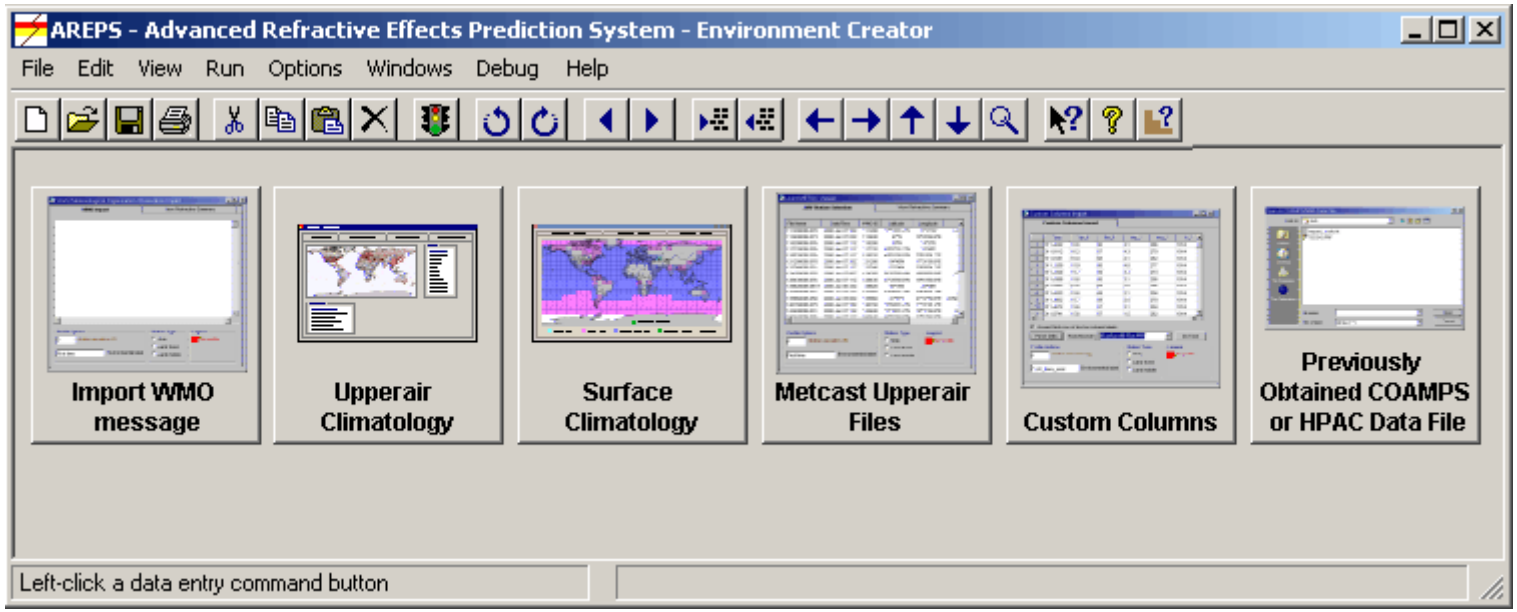

## DAMPS Homepage


DAMPS Homepage - NPMOC San Diego, CA - Microsoft Internet Explorer
DAMPS Homepage - NPMOC San Diego, CA
COAMPS Daily Forecasts

## Metcast



# Environment Window

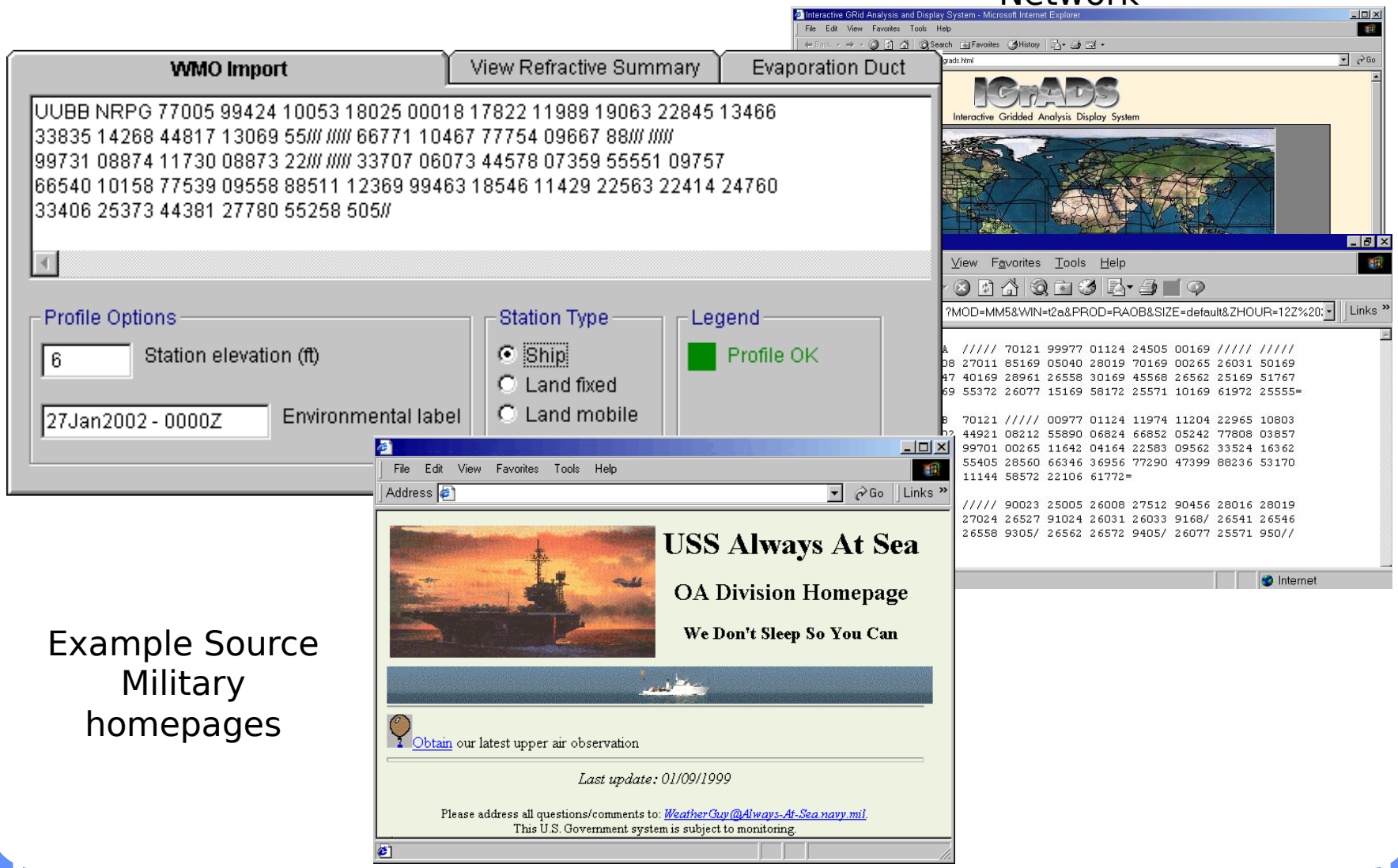


SPAWAR Systems Center San Diego

**Atmospheric Propagation Branch (2858)**

# Environmental Input WMO Code Import

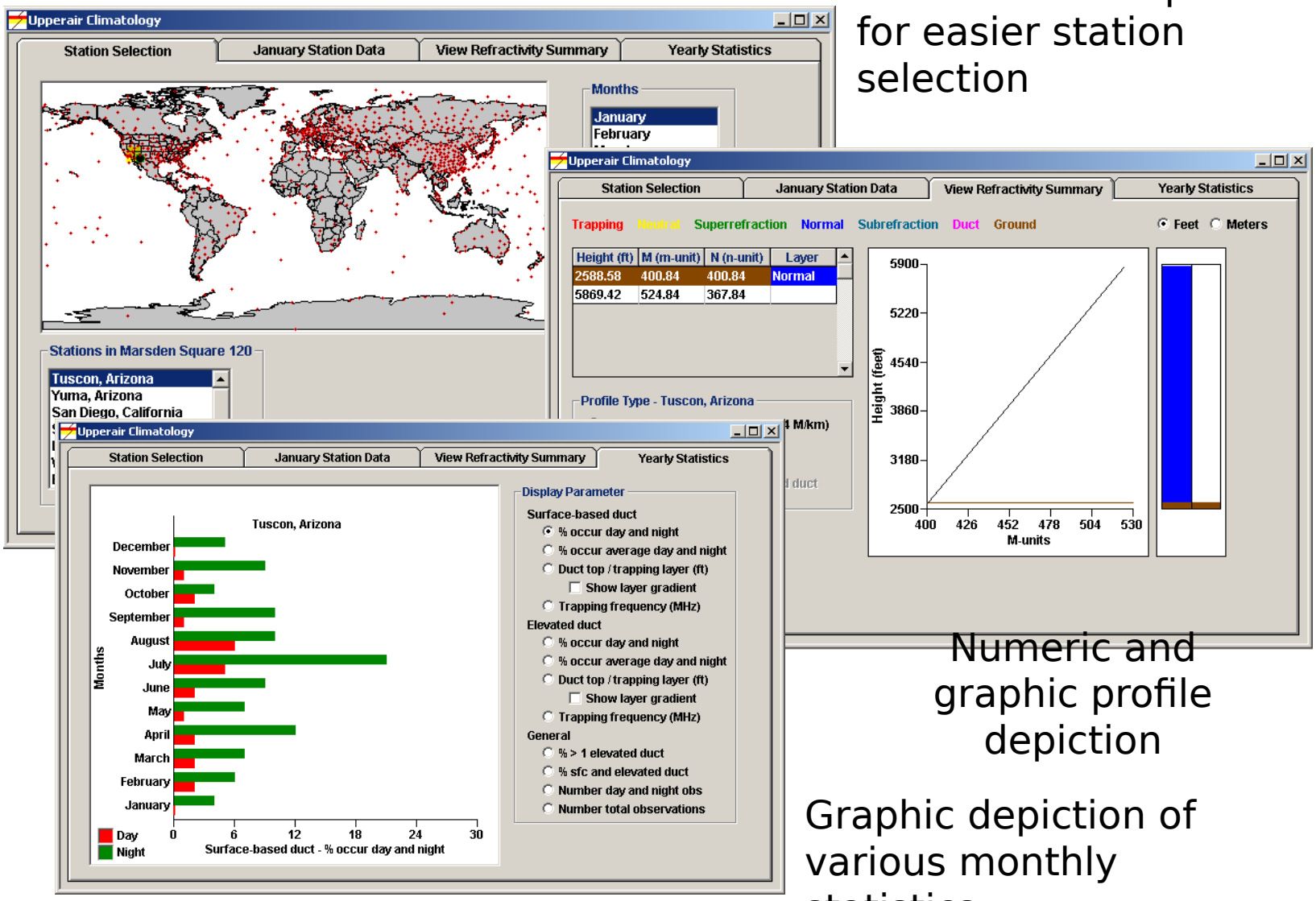
## Example Source
Joint Air Force and Army Weather Information Network


WMO Import
View Refractive Summary
Evaporation Duct
UUBB NRPG 77005 99424 10053 18025 00018 17822 11989 19063 22845 13466
33835 14268 44817 13069 55/// ///// 66771 10467 77754 09667 88/// /////
99731 08874 11730 08873 22/// ///// 33707 06073 44578 07359 55551 09757
66540 10158 77539 09558 88511 12369 99463 18546 11429 22563 22414 24760
33406 25373 44381 27780 55258 505//
Profile Options
6
Station elevation (ft)
27Jan2002 - 0000Z
Environmental label
Station Type
Ship
Land fixed
Land mobile
Legend
Profile OK
Interactive GRid Analysis and Display System - Microsoft Internet Explorer
IGrADS
Interactive Gridded Analysis Display System
?MOD=MM5&WIN=t2a&PROD=RAOB&SIZE=default&ZHOUR=12Z%20:
Links
Internet
File Edit View Favorites Tools Help
Address
Go
Links
USS Always At Sea
OA Division Homepage
We Don't Sleep So You Can
Obtain our latest upper air observation
Last update: 01/09/1999
Please address all questions/comments to: WeatherGuy@Always-At-Sea.navy.mil.
This U.S. Government system is subject to monitoring.

Example Source
Military homepages

# Upper-air Climatology

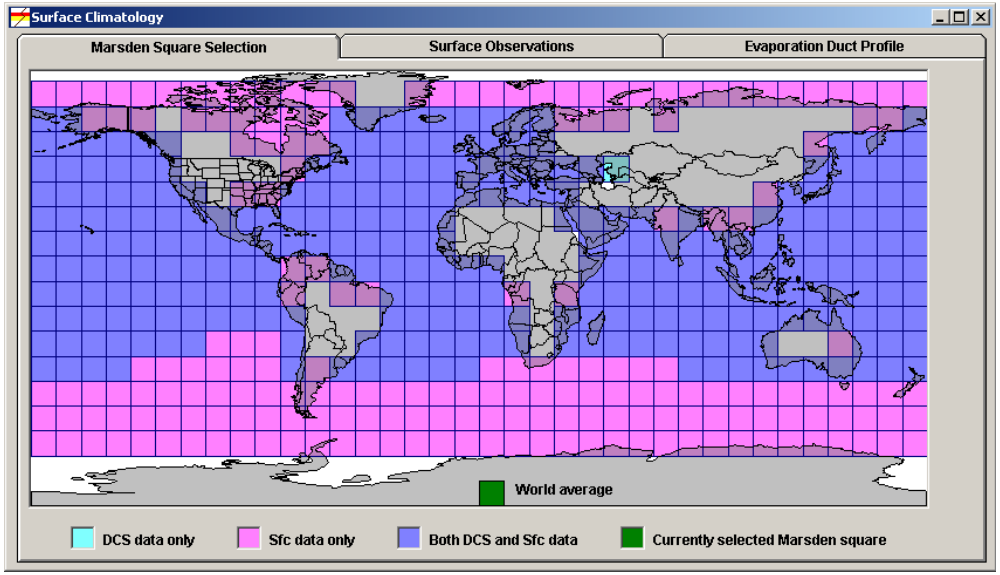
"Zoomable" map for easier station selection



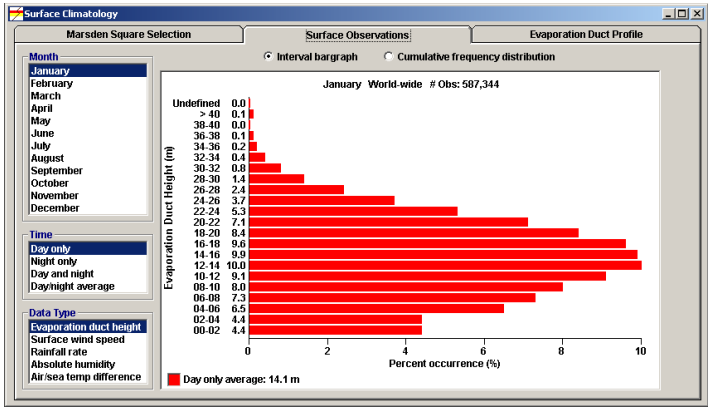

Numeric and graphic profile depiction

Graphic depiction of various monthly statistics

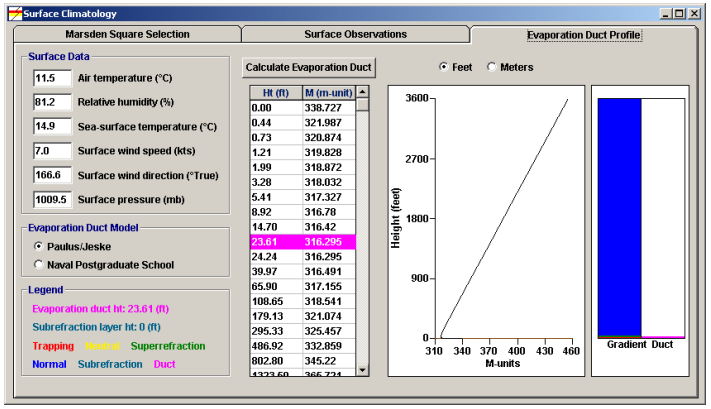
# Surface Climatology



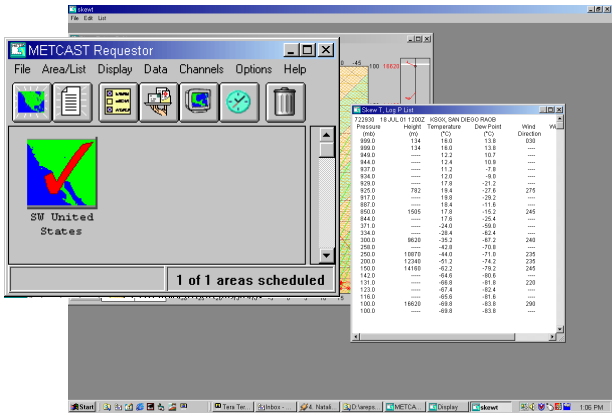

- "Zoomable" map for easier area selection
- Surface values
  - Pressure
  - Air temperature
  - Relative humidity
  - Wind speed
  - Wind direction
  - Evaporation duct heights
  - Absolute humidity
  - Air-sea temp difference
  - Rain rates




Graphic depiction of various monthly statistics




Calculated evaporation duct profiles from surface climatology values




# Metcast/JMV Method

**JMV Station Selection** | View Refractive Summary | Evaporation Duct

| File Name | Date/Time | WMO ID | Latitude | Longitude | Station Name |
|---|---|---|---|---|---|
| 70261969.09C | 1996 Sep 09 12Z | 70261 | 64°48'N | 147°54'W | Fairbanks Intl. - AK |
| 70261969.24C | 1996 Sep 24 12Z | 70261 | 64°48'N | 147°54'W | Fairbanks Intl. - |
| 722740021.14c | 2002 Jan 14 12Z | 722740 | 32°07'01.2"N | 110°55'58.8"W | KTUS, TUCSON INTL AIRPORT |
| 722930021.14c | 2002 Jan 14 12Z | 722930 | 32°49'58.8"N | 117°07'01.2"W | KSGX, SAN DIEGO RAOB |
| 72293969.09C | 1996 Sep 09 12Z | 72293 | 32°48'N | 117°06'W | San Diego, CA |
| 72293969.24C | 1996 Sep 24 12Z | 72293 | 32°48'N | 117°06'W | San Diego, CA |
| 723760021.14c | 2002 Jan 14 12Z | 723760 | 35°13'58.8"N | 111°49'01.2"W | KFGZ, FLAGSTAFF RAOB |
| 723870021.14c | 2002 Jan 14 12Z | 723870 | 36°37'01.2"N | 116°01'01.2"W | KDRA, MERCURY/DESERT ROCK |
| 72387984.09C | 1998 Apr 09 12Z | 72387 | 36°36'N | 116°W | Nellis AFB |
| 723930021.14c | 2002 Jan 14 12Z | 723930 | 34°43'58.8"N | 120°33'W | KVBG, VANDENBERG AFB |
| 724760021.14c | 2002 Jan 14 12Z | 724760 | 39°07'01.2"N | 108°31'01.2"W | KGJT, GRAND JUNCTION |
| 72489984.09C | 1998 Apr 09 12Z | 72489 | 39°36'N | 119°48'W | Reno, NV |
| 724930021.14c | 2002 Jan 14 12Z | 724930 | 37°45'N | 122°13'01.2"W | KOAK, OAKLAND |
| 72572984.09C | 1998 Apr 09 12Z | 72572 | 40°48'N | 112°W | Hill AFB |
| 72582984.09C | 1998 Apr 09 12Z | 72582 | 40°54'N | 115°42'W | Elko, NV |
| 72681984.09C | 1998 Apr 09 12Z | 72681 | 43°36'N | 116°12'W | Saylor Creek |
| 747240021.1413 | 2002 Jan 14 19Z | 747240 | 32°55'58.8"N | 112°42'W | KGBN, GILA BEND (AAF) |

**Profile Options**

0 Station elevation (ft)

First time Environmental label

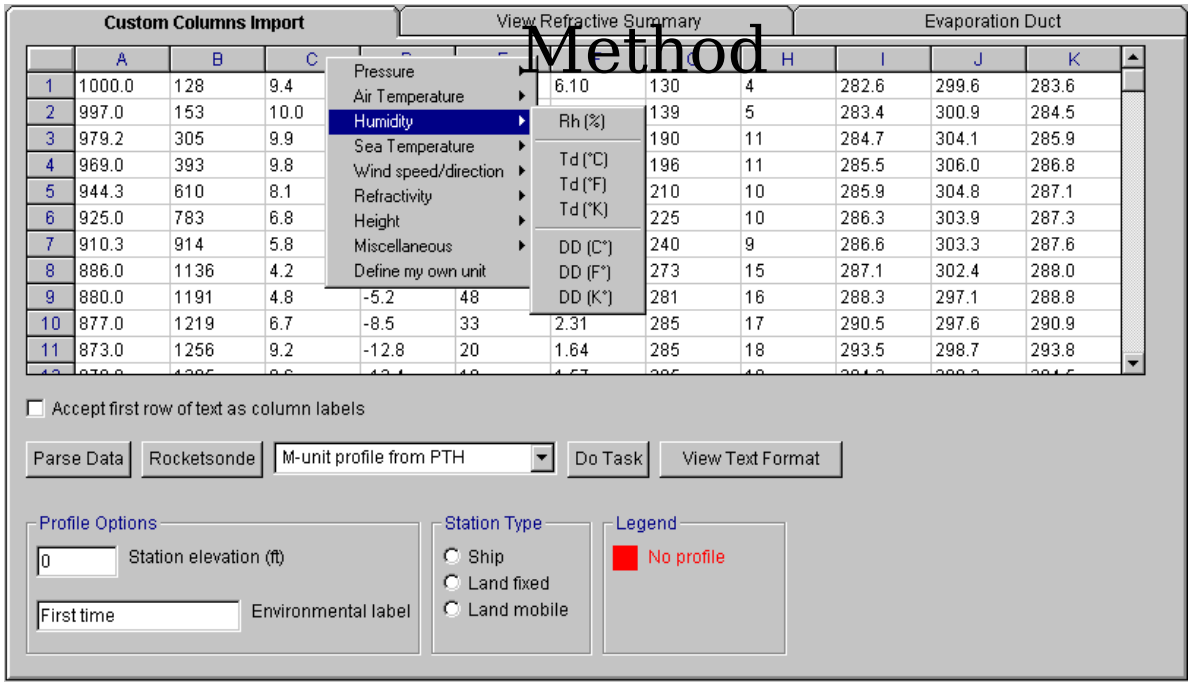
**Station Type**

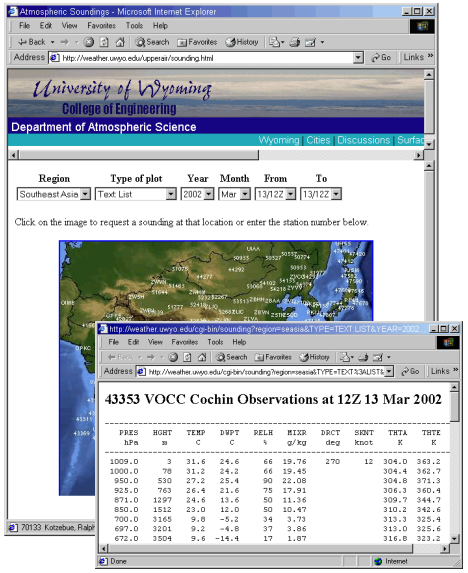
- Ship
- Land fixed
- Land mobile

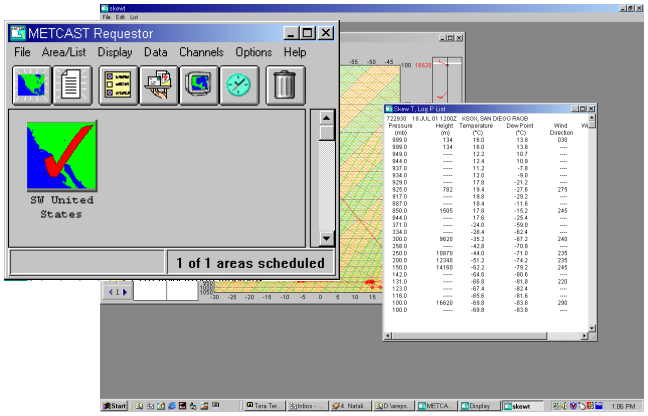
**Legend**

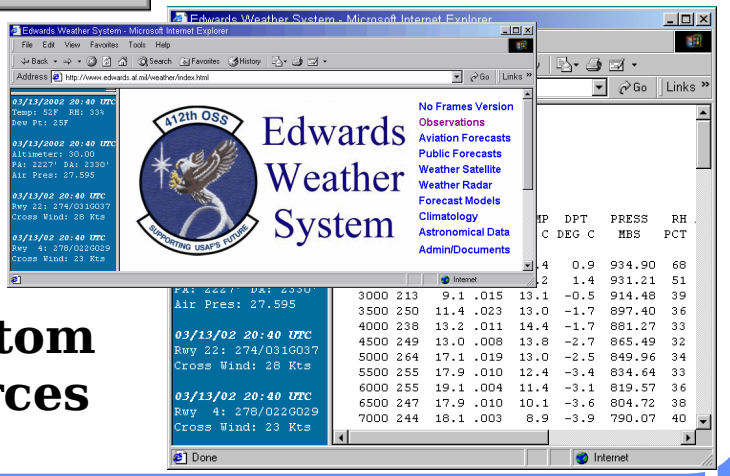
No profile

# Environmental Input Custom Column Method



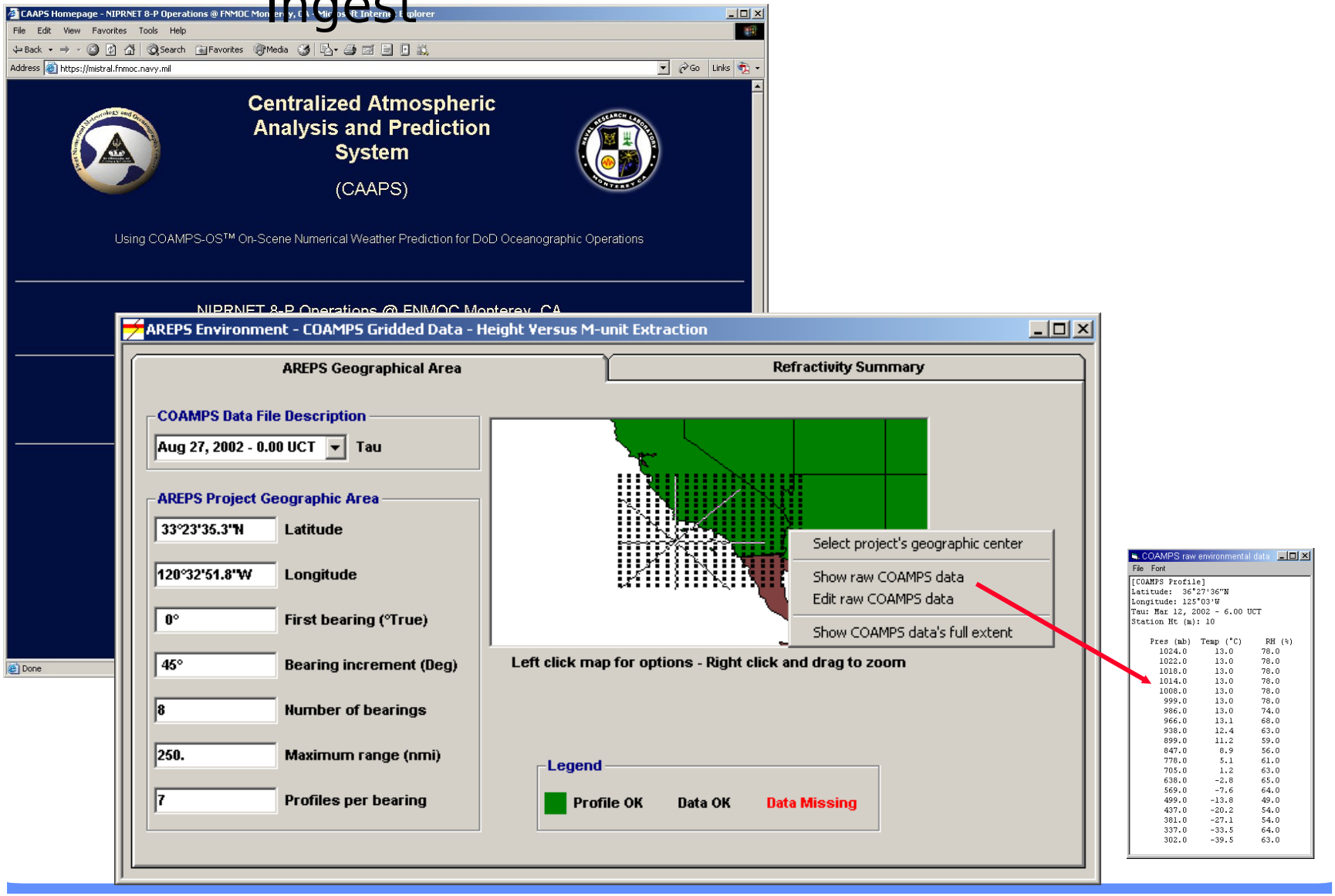


Atmospheric Soundings - Microsoft Internet Explorer
University of Wyoming
College of Engineering
Department of Atmospheric Science
Region
Type of plot
Year
Month
From
To
Click on the image to request a sounding at that location or enter the station number below.
43353 VOCC Cochin Observations at 12Z 13 Mar 2002



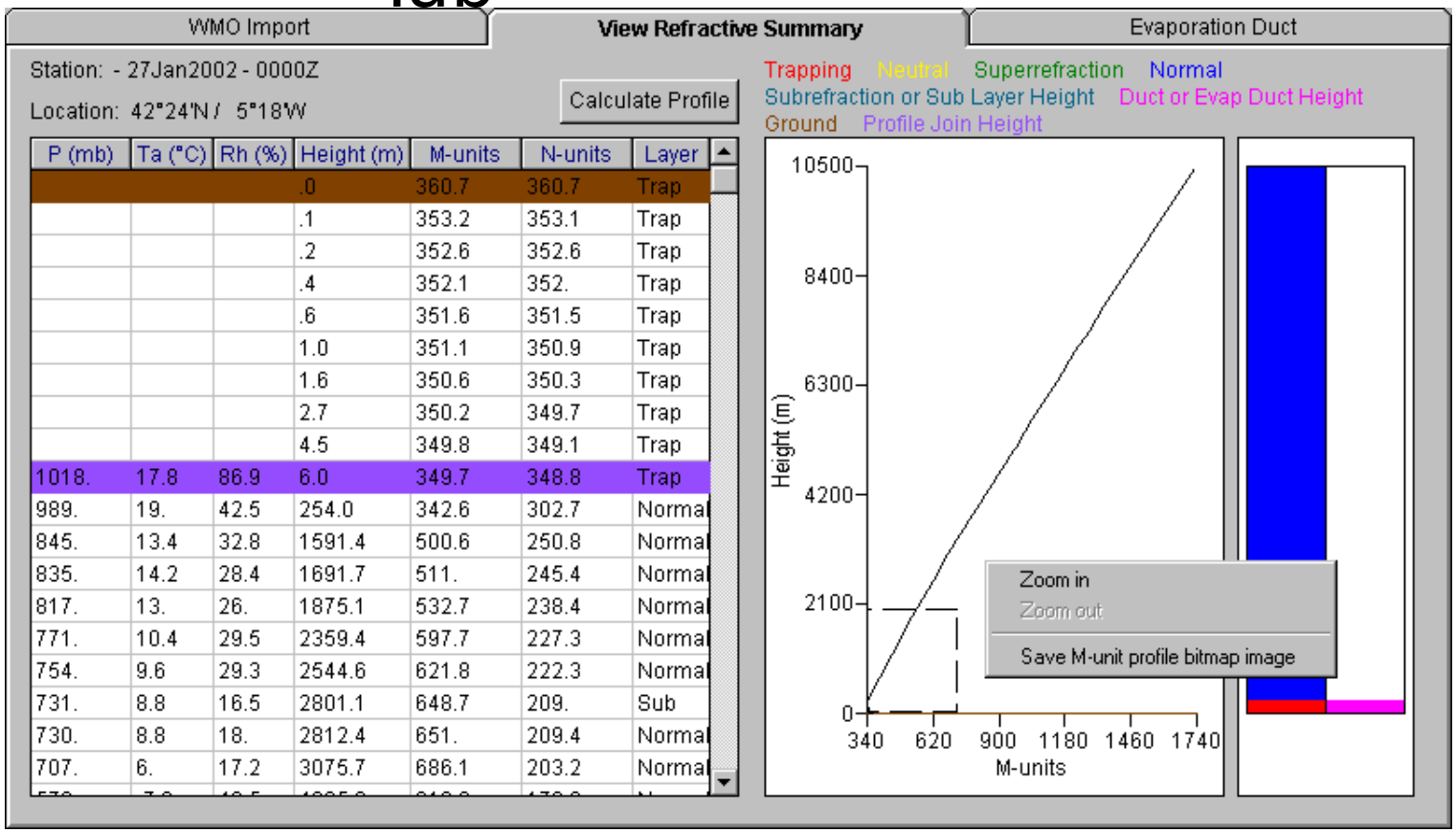




## Example Custom Column Sources

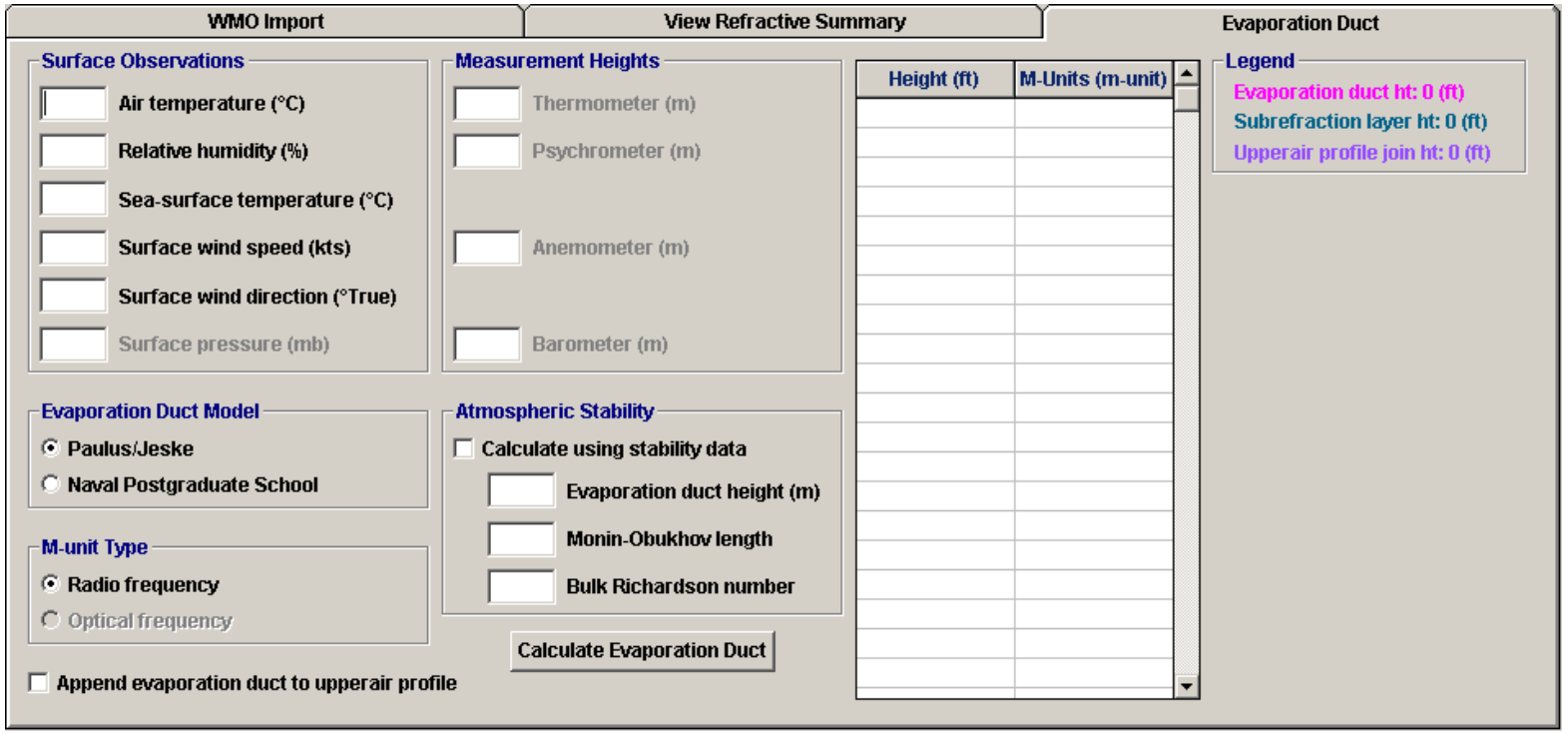
# Mesoscale Meteorological Model Data Ingest



# Refractivity Summary Tab


WMO Import
View Refractive Summary
Evaporation Duct
Station: - 27Jan2002 - 0000Z
Location: 42°24'N / 5°18'W
Calculate Profile
Trapping Neutral Superrefraction Normal
Subrefraction or Sub Layer Height Duct or Evap Duct Height
Ground Profile Join Height
P (mb) Ta (°C) Rh (%) Height (m) M-units N-units Layer
.0 360.7 360.7 Trap
.1 353.2 353.1 Trap
.2 352.6 352.6 Trap
.4 352.1 352. Trap
.6 351.6 351.5 Trap
1.0 351.1 350.9 Trap
1.6 350.6 350.3 Trap
2.7 350.2 349.7 Trap
4.5 349.8 349.1 Trap
1018. 17.8 86.9 6.0 349.7 348.8 Trap
989. 19. 42.5 254.0 342.6 302.7 Normal
845. 13.4 32.8 1591.4 500.6 250.8 Normal
835. 14.2 28.4 1691.7 511. 245.4 Normal
817. 13. 26. 1875.1 532.7 238.4 Normal
771. 10.4 29.5 2359.4 597.7 227.3 Normal
754. 9.6 29.3 2544.6 621.8 222.3 Normal
731. 8.8 16.5 2801.1 648.7 209. Sub
730. 8.8 18. 2812.4 651. 209.4 Normal
707. 6. 17.2 3075.7 686.1 203.2 Normal
10500
8400
6300
4200
2100
0
Height (m)
340 620 900 1180 1460 1740
M-units
Zoom in
Zoom out
Save M-unit profile bitmap image

# Evaporation Duct Tab



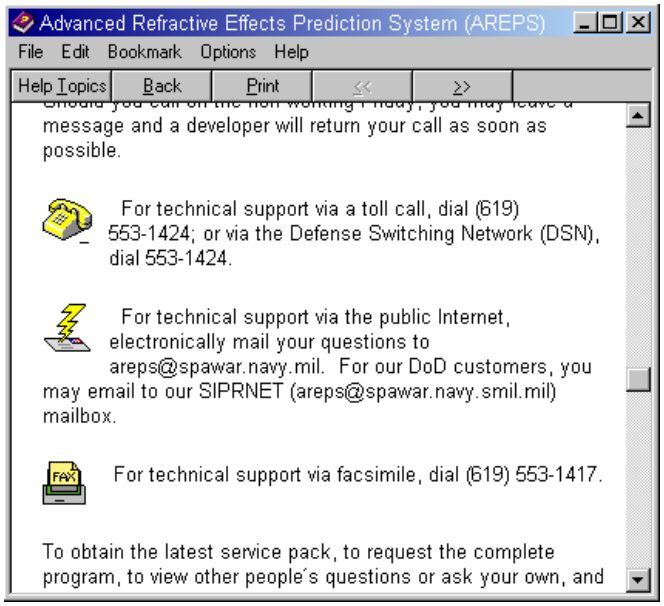
SPAWAR Systems Center San Diego

# AREPS On-line Help Opportunities

E-mail
Internet:
areps@spawar.navy.mil

Homepages
Internet:
http://sunspot.spawar.navy.mil

Internet: http://mskc.spawar.navy.mi


Advanced Refractive Effects Prediction System (AREPS)
File Edit Bookmark Options Help
Help Topics Back Print
message and a developer will return your call as soon as possible.
For technical support via a toll call, dial (619) 553-1424; or via the Defense Switching Network (DSN), dial 553-1424.
For technical support via the public Internet, electronically mail your questions to areps@spawar.navy.mil. For our DoD customers, you may email to our SIPRNET (areps@spawar.navy.smil.mil) mailbox.
FAX
For technical support via facsimile, dial (619) 553-1417.
To obtain the latest service pack, to request the complete program, to view other people´s questions or ask your own, and

Metoc Systems Knowledge Center HomePage - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Address http://mskc.spawar.navy.mil/
Unclassified Web Page
METOC Systems Knowledge Center
Continue Login
Request Site Authorization
(** Need access, fill out the request form **)
Login Help (Requires JavaScript be enabled)
WARNING!! USE OF THIS OR ANY OTHER DEPT. OF DEFENSE INTEREST COMPUTER SYSTEM (DODICS) CONSTITUTES AN EXPRESS CONSENT TO MONITORING AT ALL TIMES. This DODICS and all related equipment are to be used for the communication, transmission, processing, and storage of official U.S. Government or other authorized information only. All DODICS are subject to monitoring at all times. If monitoring of any DODICS reveals possible violation of criminal statutes, all relevant information may be provided
M S K C
METOC Systems Knowledge Center
Make Support Available Everywhere.

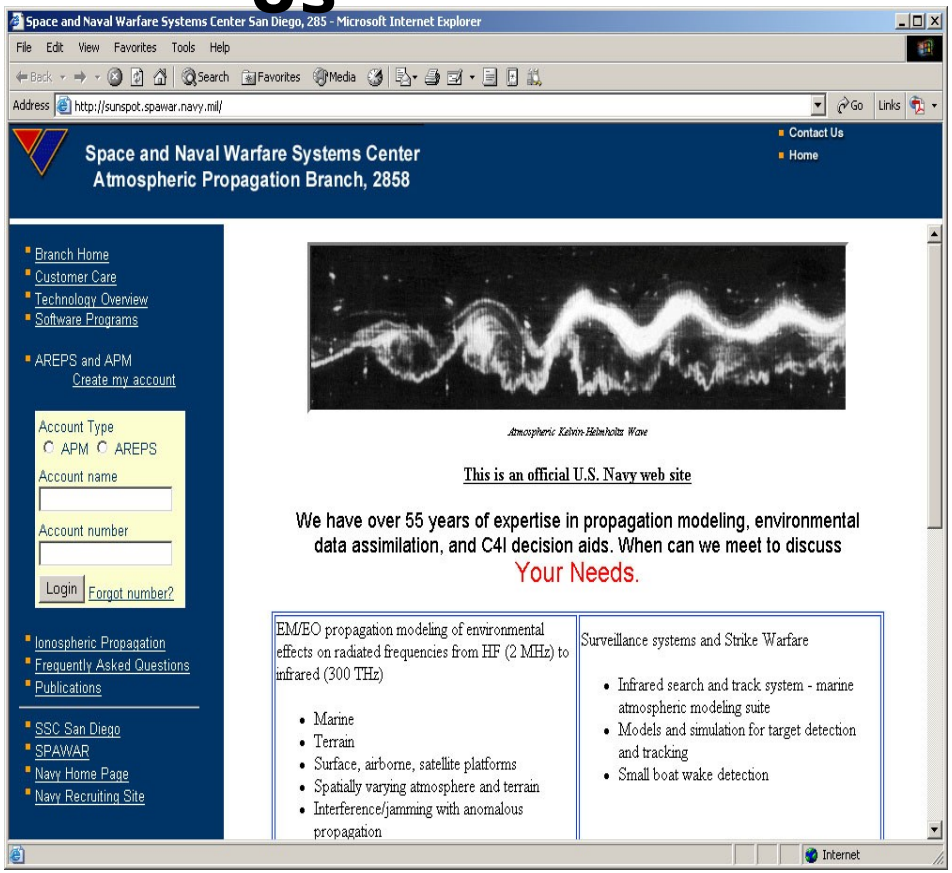
# Summary

1. SSC San Diego, Atmosphere Propagation Branch has over 55 years of expertise in propagation modeling, environmental data assimilation, and C4I decision aids.
2. APM is the only N096/N61 accredited EM (100 MHz – 57 GHz) propagation model
3. APM and AREPS are elements of the Defense Modeling and Simulation Office (DMSO) and Navy Modeling & Simulation Management Office (NAVMSMO) library
4. AREPS is a Functional Area Manager (FAM) certified application within the Department of the Navy's Application and Database Management System (DADMS).
5. AREPS is NMCI certified
6. AREPS is NATO approved, Military Committee Meteorological Group/WG - Battle Area Meteorological Systems and Support plus with Partners

When can we meet to discuss **your needs** in greater detail?

SPAWAR Systems Center San Diego

# How to Contact Us


Space and Naval Warfare Systems Center San Diego, 285 - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Address http://sunspot.spawar.navy.mil/
Space and Naval Warfare Systems Center
Atmospheric Propagation Branch, 2858
Contact Us
Home
Branch Home
Customer Care
Technology Overview
Software Programs
AREPS and APM
Create my account
Account Type
APM AREPS
Account name
Account number
Login
Forgot number?
Ionospheric Propagation
Frequently Asked Questions
Publications
SSC San Diego
SPAWAR
Navy Home Page
Navy Recruiting Site
Atmospheric Kelvin-Helmholtz Wave
This is an official U.S. Navy web site
We have over 55 years of expertise in propagation modeling, environmental data assimilation, and C4I decision aids. When can we meet to discuss Your Needs.
EM/EO propagation modeling of environmental effects on radiated frequencies from HF (2 MHz) to infrared (300 THz)
Marine
Terrain
Surface, airborne, satellite platforms
Spatially varying atmosphere and terrain
Interference/jamming with anomalous propagation
Surveillance systems and Strike Warfare
Infrared search and track system - marine atmospheric modeling suite
Models and simulation for target detection and tracking
Small boat wake detection
Internet


Commercial
(619) 553-1423

DSN
553-1423

Facsimile
(619) 553-1417

E–mail AREPS
areps@spawar.navy.mil
areps@spawar.navy.smil.mil


Public Internet - http://sunspot.spawar.navy.mil